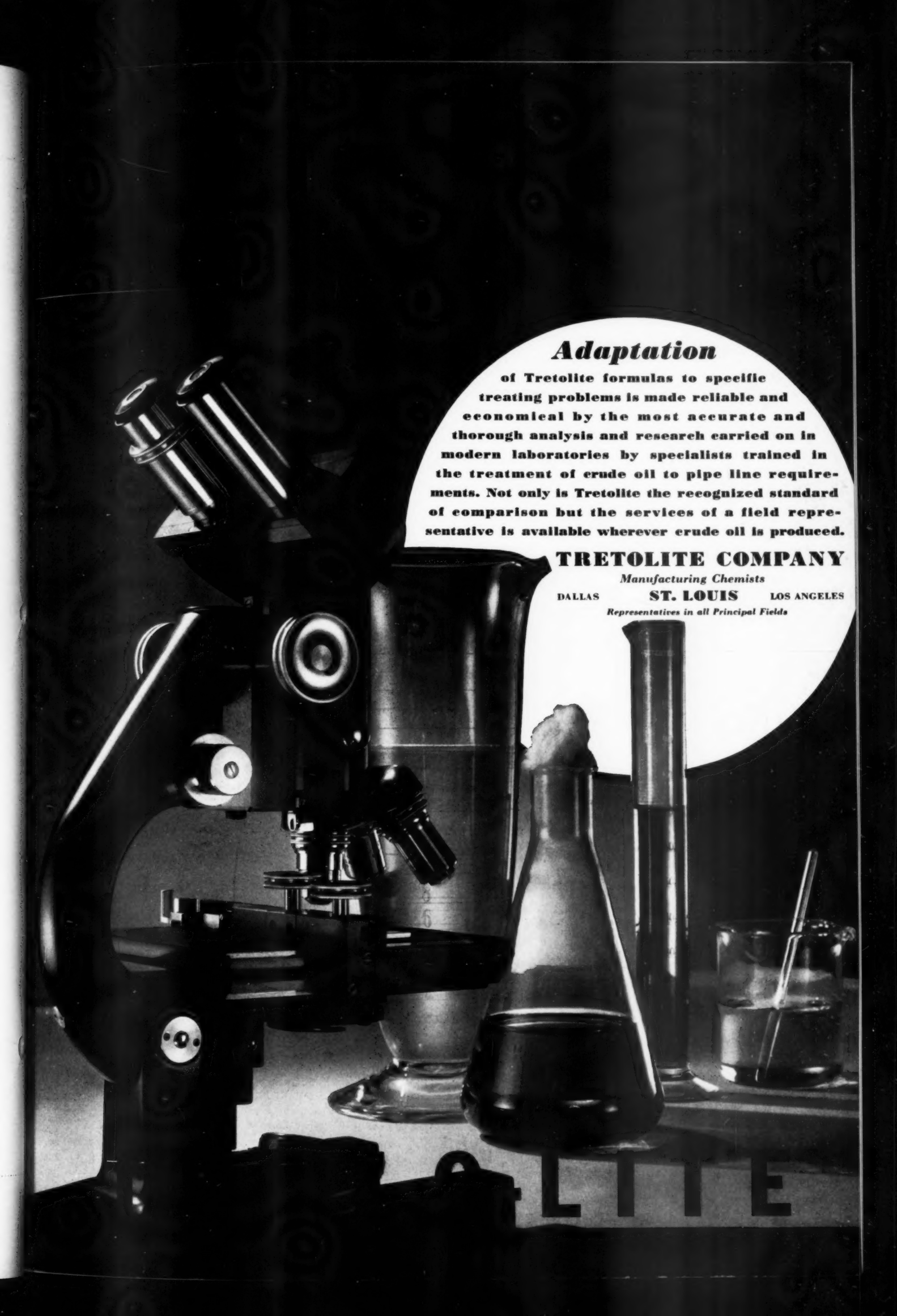
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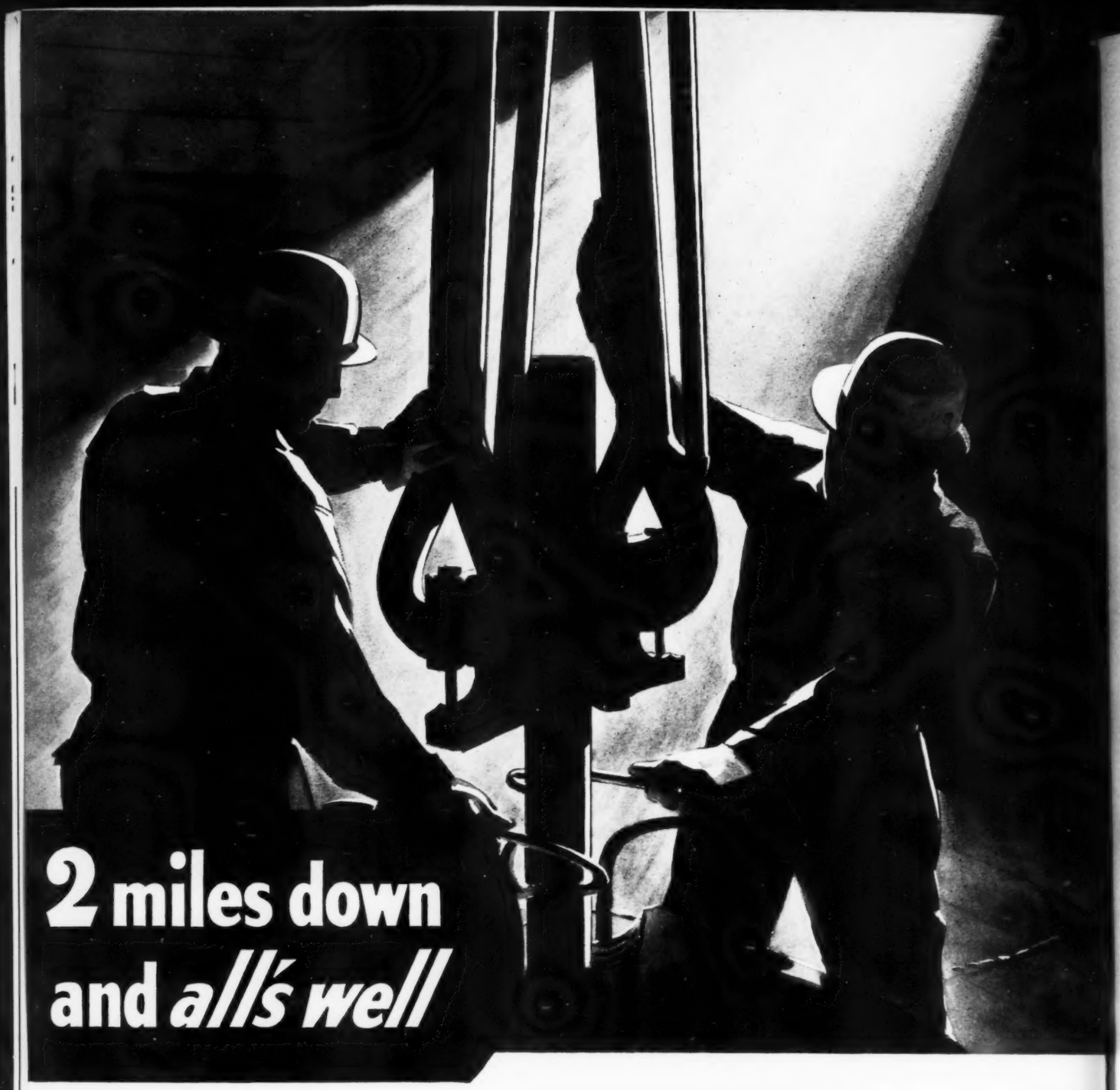

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A MAGAZINE OF METHODS FOR OPERATING MEN

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MEETINGS

Western Petroleum Refiners Association, Regional Technical Meeting—September 29, Allis Hotel, Wichita, Kansas.

American Association of Petroleum Geologists, Mid-Year Meeting—September 27, 28, 29, 30, October 1, and 2, El Paso, Texas.

California Natural Gasoline Association—October 6, Richfield Building, Los Angeles, California.

Society of Automotive Engineers, National Regional Fuels and Lubricants Meeting—October 6 and 7, Tulsa, Oklahoma.

American Institute of Mining and Metallurgical Engineers, Petroleum Division—October 6 and 7, San Antonio, Texas.

American Gas Association—October 10, 11, 12, 13, and 14, Atlantic City, New Jersey.

National Stripper Well Association, Annual Meeting—October 18, Tulsa, Oklahoma.

Oklahoma Stripper Well Association, Annual Meeting—October 18, Tulsa, Oklahoma.

Independent Petroleum Association of America—October 19, 20, and 21, Tulsa, Oklahoma.

Mid-Continent Oil and Gas Association, Texas Division—October 27, 28, and 29, San Antonio, Texas.

American Association of Petroleum Geologists, Pacific Section—November 3 and 4, Los Angeles, California.

American Petroleum Institute, 19th Annual Meeting—November 14, 15, 16, 17, and 18, Stevens Hotel, Chicago, Illinois.

American Society of Mechanical Engineers—December 4, 5, 6, 7, 8, and 9, Philadelphia, Pennsylvania.

Oil-World Exposition—April 24, 25, 26, 27, 28, and 29, 1939, Houston, Texas.

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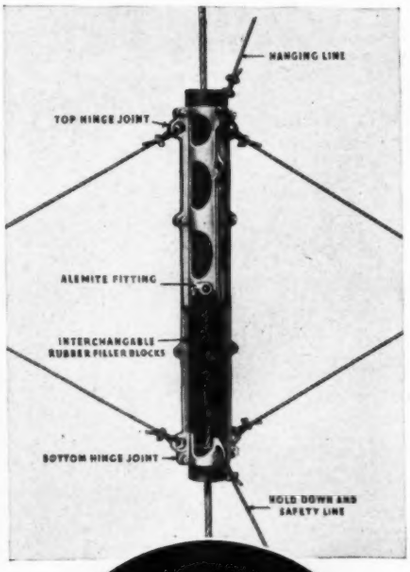

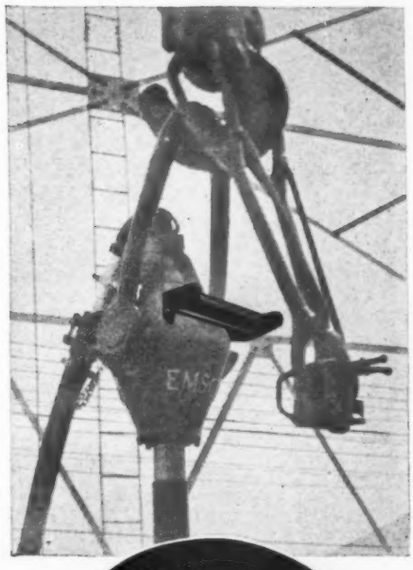

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The Course of Oil

By K. C. SCLATER

Further Government Meddling

Issues loom that are of some concern to the oil industry. One is the veiled threat seen in the statement voiced by Thurman Arnold, "that Congress might well consider that marketing of gasoline has become a public utility."

What significance has this utterance? It may be a straw in the wind, pointing to investigations to be made in an attempt to prove the existence of monopolistic practices in the oil industry. The industry will be well advised to watch its step and be prepared for attacks by the anti-monopolists. It may be a prelude to further meddling of government in business.

States Compact Renewal

Another question of some moment to the industry is that of the renewal of the States Compact. The States Compact Commission will meet in Tulsa late this month.

The opinion prevails in some quarters that the States Compact Commission should be given more power than it now possesses. Fear is expressed that to do so would change the Commission from an advisory body to a body charged with the regulation (by Federal control) of oil production among the states. It may be true that unless the Compact Commission has greater powers than it now possesses, it can not control all factors having to do with inequities, but whether such a change is advisable remains to be seen. A report touching on this question may be forthcoming at the meeting. Certainly there are many inequities existing, but whether these could or should be rectified by the States Compact Commission is open to serious question.

Proration Method Assailed

For years many operators in the East Texas field have been dissatisfied with the method of proration there. Objections and complaints have been made repeatedly—and seemingly in vain—to the State Railroad Commission. Even so, the East Texas field is an object lesson to the industry in conservation. It is a practical demonstration of the wisdom of conserving reservoir energy. This conservation has been accomplished by restricting production to a figure that experience and engineering data have shown to be reasonable. The life of the field has been prolonged. Low lifting costs have been maintained and the probable ultimate recovery increased.

Acreage has never been considered in prorating the allowable production of wells in the East Texas field. It is conceded that there may be probably good reason for this. The early development of the field was so rapid, the field so great in extent, and operating interests were so diverse that it was difficult to regulate production in the field by any method. By the time operators had become educated to the advantages of restriction it appeared to be too late to consider the acreage factor. It would have resulted in hardship on many operators who developed their properties in good faith on the assumption that the method of proration in use would be continued.

Another problem was confronted at a later date that unfortunately was not so easy to cope with successfully. This problem had also to do with acreage. The Commission was compelled to consider applications for permission to drill on small tracts, and many exceptions to Rule 37 were granted. This resulted in many inequities. Parts of the field have been drilled to a density that is beyond sound economic limits.

A suit is now pending assailing the method of proration in use. The complainants have a tract of about 25 acres that is offset by a small tract of one-tenth of an acre. The well on the one-tenth of an acre is allowed to produce as much oil as each of five wells the spacing of each of which is about five acres. It is contended that under Rule 37 the property rights of the plaintiffs are violated. They have no protection against drainage. They assert that the Commission has refused to make an adjustment to remove the inequity.

What view the court will take on redressing this grievance may affect future operations in the East Texas field. There is so much evidence supporting the fact that the plaintiffs' rights have been violated and that gross inequities exist through failure to include acreage in proration that, no matter what the court's decision, it is almost certain to have a salutary influence on future proration regulations in Texas.

Illinois Development Booming

Illinois has no proration. Drilling operations there are more active than in any part of the country at the present time. The daily production has almost trebled since the first of the year and may increase by the end of the year to a total of 100,000 barrels daily. Companies seem to be taking full advantage of the fact that expenditures on development in Illinois offer greater possibilities of a quicker return than elsewhere. Development is orderly and is expected to remain so. Efficient methods are in use so that there is no wanton waste of the type that characterized boom fields of the past.

Prosperity and the Individual

In the current issue of *The Lamp* some figures are released that bring home some vital facts relating to business prosperity and the individual. For example, for each dollar of dividend money distributed last year in the United States by the Standard Oil Company of New Jersey the company paid to its own employees $1.48. For each dollar of dividend, the company paid to the various tax collectors, including gasoline taxes, $1.55. In addition the company paid for supplies that included crude oil, steel, rent, transportation, and thousands of other items, representing millions of dollars more. These figures show that there is a very close connection between business prosperity and the individual.

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« « HIGHLIGHTS IN OILDOM » »

East Texas Crude Price Reduced 10 Cents Bbl.

Most crude oil purchasers in the East Texas field have fallen in line and met the reduced quotation of $1.25 a barrel. The Atlantic Refining Company, the Humble Oil and Refining Company, Cities Service Oil Company, The Texas Company, Sinclair Prairie Oil Marketing Company, Shell Petroleum Corporation, Bell General Pipe Line Company, and the Premier Refining Company posted a price of $1.25 a bbl. effective as of August 29. The Tide Water-Associated Oil Company met the price as of August 30. The American Liberty Pipe Line Company followed as of September 1.

●

12-cent Reduction in Pennsylvania Crude Prices

For the sixth time within a year Pennsylvania Grade crude oil has been reduced in price. The latest reduction, effective September 1st, was 12 cents a bbl., and was announced by the South Penn Oil Company. The new prices are: Bradford and Allegheny districts, $1.68 a bbl.; Southwest Pennsylvania, $1.34 a bbl.; Eureka, $1.28 a bbl.; and Buckeye, $1.18 a barrel.

Prices of Pennsylvania Grade crude are now at their lowest level since July, 1933.

●

Inaugurates Active Administration of Natural Gas Act

The Federal Power Commission has inaugurated active administration of the Natural Gas Act, introduced by Congressman Clarence F. Lea of California, and approved June 21, 1938, by adopting three orders affecting the industry. Order No. 51 institutes an investigation of natural gas companies and directs the filing of reports. Order No. 52 promulgates and prescribes provisional rules of practice and regulations under the act, and Order No. 53 directs the filing by natural gas companies of schedules of rates and charges, contracts and agreements for the transportation and sale of natural gas now under the commission's jurisdiction.

"Filling a field heretofore unoccupied, the Natural Gas Act brings interstate natural gas utilities under the same general supervision that has been exercised over electric utilities under the Federal Power Act", said Acting Chairman Clyde L. Seavey in announcing the commission's orders.

"Regulation by this commission is confined by Congress to the transportation of natural gas in interstate commerce, to the sale in interstate commerce of natural gas for resale for ultimate public consumption for domestic, commercial, industrial, or any other use, and to companies engaged in such transportation or sale. The act specifies that it shall not apply to any other transportation or sale of natural gas or to the local distribution of natural gas or to the facilities used for such distribution or the production or gathering of natural gas."

●

Validity of Prorating Method Attacked in Suit

The Texas Railroad Commission's right to prorate oil production in the East Texas field solely on the potential factor basis has been attacked in Federal Court by the Rowan and Nichols Oil Company of Fort Worth. This is the first attack in about eight months on the potential method of proration. The last test was won by the commission when the Supreme Court of the United States refused Angus Spears an injunction.

A temporary injunction and the convening of a three-judge Federal Court to hear the application for an interlocutory injunction upon final trial is sought in the suit. Just when a hearing will be held is doubtful as the two resident judges in the district are on vacation.

●

Granted Concession For Prospecting In Iraq

The minister of economics and communication, speaking for the Government of Iraq, has announced that John Skliros, acting for the Basrah Petroleum Company (Iraq Petroleum Company), has obtained a concession for developing oil lands in southern Iraq. The company has a stated capital of £1,000,000.

The conditions of the concession have not been made public, but in a brief statement the government described them as more advantageous for Iraq than those of previous concessions. Considerable importance seems to be attached to this negotiation, which has formed the object of numerous conferences for several months.

●

Increased Use Gas and Gas Products in Texas

Daily average gas production figures for Texas for the first six months of 1938, as compared with the first half of 1937, show a marked increase in the use of natural gas and natural gas products, according to a report of the Engineering Department, Oil and Gas Division, Texas Railroad Commission. Dry sweet gas production increased five percent this year, sour gas production increased 19.50 percent, and casinghead gas utilization increased 19.02 percent.

Daily average gas to gasoline plants increased 9.42 percent, and gasoline production from these plants increased 24.62 percent. Gas to carbon black plants increased 8.98 percent, and carbon black production decreased 4.82 percent.

Included in the report for the first time is the amount of condensate recovered from wells classified as gas wells. For July the condensate production from gas wells averaged 6315 bbl. per day from 319 wells.

●

California Property Owners Win First Battle

California property owners won their first battle with the federal government over seizure of state tidelands in the Santa Ana Superior Court. Superior Judge Turrentine, of San Diego, sitting pro tem at Santa Ana, ruled the federal government has no title to Huntington Beach tideland oil.

The court overruled a demurrer and denied a motion for dismissal by George B. Bush, Los Angeles attorney, representing two defendants in trespass suits brought by the state.

"This marks our first major victory in protecting the property owners of California," Ralph F. Forch, president of the United Landowners Association, said. "The threatened grab of state-owned tidelands by the federal government menaces ownership of property having a potential oil yield valued at upwards of one billion dollars. It is an invasion of state rights and state sovereignty. We anticipate more of this kind of litigation, and we are prepared, with every available legal means, to face them."

Bush contended the federal government did not deed to the state the rights it acquired by virtue of the century-old Gaudalupe Hidalgo Treaty with Mexico, that the state had no jurisdiction, and had no right to sue trespassers or to permit drilling in tideland oil pools. This contention was held not valid by Judge Turrentine.

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Latest Activities In The Oil Fields

SUN OIL COMPANY'S No. 1 Mrs. Amanda McKinney, in the A. J. Smith Survey, northeastern Starr County, Texas, flowed six bbl. of pipe line oil per hour through $\frac{5}{32}$-in. choke. About 16 ft. of saturated sand was cored at a depth of 4842 to 4858 ft. and 7-in. casing was set and cemented at the total depth of 4858 feet. The plug was drilled to a depth of 4856½ ft. and the casing perforated with 12 shots between 4853½ and 4856½ feet. Tubing pressure is 500 lb. and casing pressure 800 pounds. Production was being closely restricted pending construction of storage facilities and a pipe line. The oil is obtained from the base of the Frio or the top of the Vicksburg. Humble Oil and Refining Company's No. 2 Kelsey Bass, seven miles southeast of Agua Nueva, Jim Hogg County, Texas, and ten miles north of the Sun company well, flowed two bbl. of oil per hour through a small choke. Total depth of the well is 4754 ft. and the casing is perforated at a depth of 4744 to 4748 feet. Tubing pressure was 1575 lb. and casing pressure 1657 pounds. Some persons think the two wells are producing from the same formation in a single large field.

●

Mildred Oil Company and Kerlyn Oil Company's No. 1 L. C. Neathery, in Charles Quillen Survey, one mile southeast of Collinsville, Grayson County, Texas, when bailed flowed by heads at a rate estimated to be 200 bbl. per day. The well was plugged back to a depth of 3920 ft. and the $5\frac{3}{16}$-in. casing gun-perforated at a depth of 3862 to 3874 feet. Gravity of the oil is 31.6 deg. A.P.I. and the producing formation is correlated with the Deese sand, productive farther northwest.

●

H. E. Sloan's No. 1 Philip Walker, in the northwest corner of 16-35-9e, Leech township, Wayne County, Illinois, and 12 miles from the nearest production, flowed at the rate of 500 bbl. per day from the McClosky sand. It is anticipated that acid treatment will increase the rate of production somewhat.

Pryor, Lockhart, and Foster's No. C-1 Gant, in the northeast corner of 18-31s-13w, Barber County, Kansas, produced 1211 bbl. of oil per day from Arbuckle limestone after treatment with acid. This is the first well in the county to produce oil from the Arbuckle formation.

●

A. T. Strong's No. 1 J. M. Smith, in section 639, T. E. & L. Survey, Young County, Texas, and a mile east of the James pool, produced 50 bbl. of oil per hour and 4,000,000 cu. ft. of gas per day after treatment with 10,000 gal. of acid at a depth of 3847 to 3953 feet. Casing was set at a depth of 3846 feet.

●

Charles D. Hagerty and Lee Petroleum Corporation's No. 1 James Callan, in the northwest corner of the east half of section 38, M. Franz survey, Menard County, Texas, produced an estimated 250,000 cu. ft. of dry sweet gas per day from a depth of 1267 feet. The $5\frac{3}{16}$-in. casing was set at a depth of 1200 feet.

●

H. L. Rowley's No. 1 Max Sittner, in 35-21s-12w, Stafford County, Kansas, produced 1230 bbl. per day from the Arbuckle limestone. The well is one and one-half miles northeast of the Sittner South pool and has been designated the Sittner East area.

●

Helmerich and Payne, Inc., and Continental Oil Company's No. 1-G-36 State, in NW SW 36-17s-35e, Lea County, New Mexico, two miles southeast of the Vacuum pool, flowed 40.3-deg. gravity sweet oil accompanied by an estimated 1,000,000 cu. ft. of gas per day on drill stem test made at a depth of 4790 to 4920 feet. The well is about 250 ft. low, structurally, as compared with the nearest wells in the field proper.

AVERAGE CRUDE PRICES

California	
Kettleman Hills	$1.19-1.43
Playa Del Rey	.80-1.16
Coalinga	.70- .90
Signal Hill	.80-1.21
Montana	1.35
Wyoming	.97-1.30
Colorado	1.01-1.25
New Mexico	.78-1.08
Texas	
North Central	.96-1.20
Panhandle	.91-1.08
West Texas	.78-1.08
Gulf Coast	.95-1.41
Darst Creek	1.09
East Texas	1.25
Talco	.73
Kansas	.98-1.30
Oklahoma	.98-1.30
Arkansas	.90
Louisiana	
Rodessa	$ .91-1.25
Gulf Coast	.84-1.41
North Louisiana	.90-1.22
Illinois	1.35
Kentucky	1.30
Indiana	1.12
Ohio	
Lima	1.00
Michigan	1.27
Pennsylvania	
Bradford	1.68
Southwest	1.34
Eureka	1.28
Buckeye	1.18
Corning	1.17
West Virginia	1.67
Canada	2.10-2.17

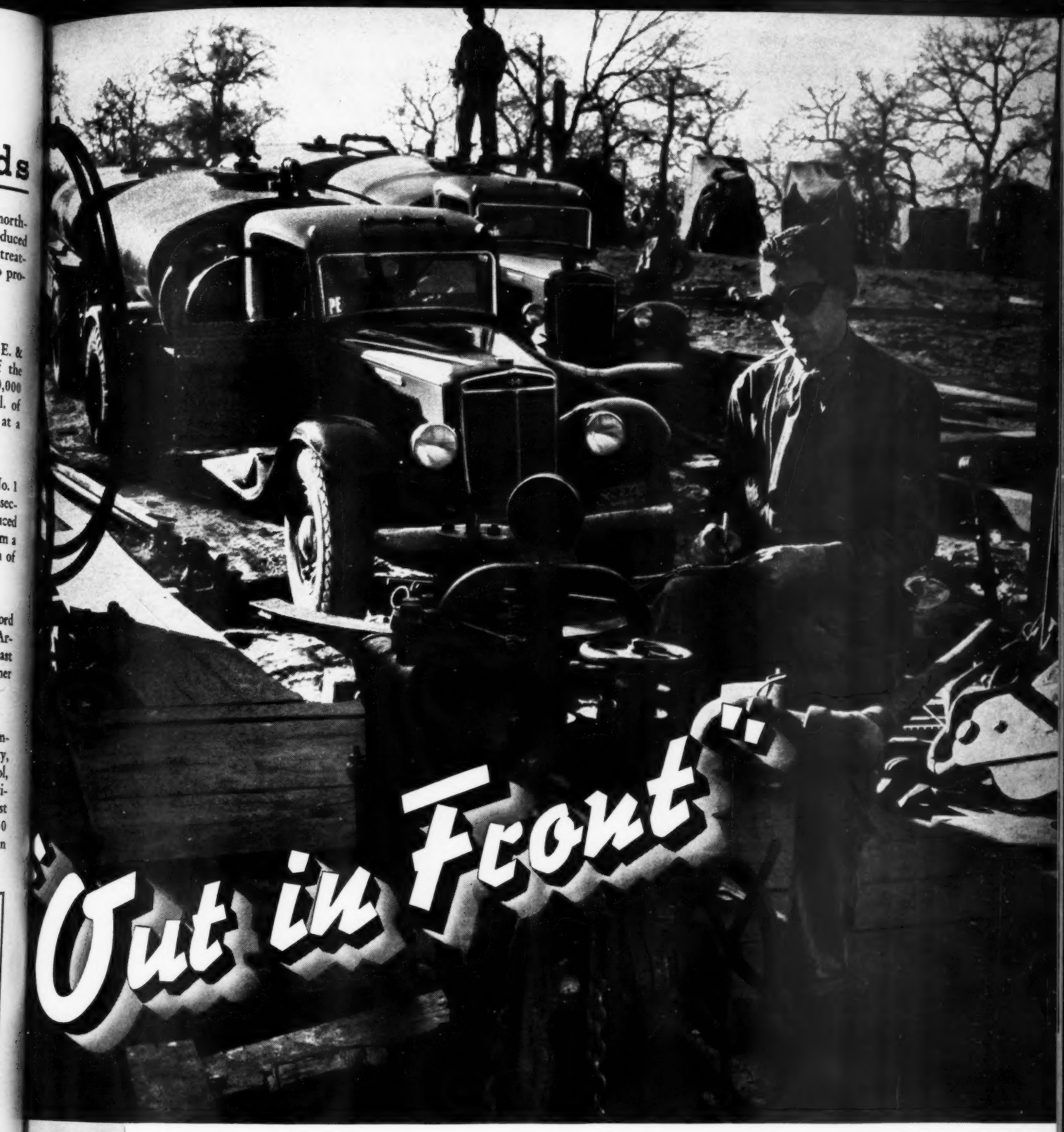
DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

(Figures in Barrels)

	[1]B. of M. Dept. of Int. Calculations (September)	Week Ended Sept. 3, 1938	Week Ended July 30, 1938	Week Ended Sept. 4, 1937
Oklahoma	528,300	432,400	422,600	639,500
Kansas	168,000	161,200	154,000	192,550
Panhandle Texas		69,600	72,350	80,150
North Texas		70,350	78,600	74,850
West Central Texas		27,950	29,200	33,800
West Texas		220,600	218,700	232,850
East Central Texas		96,950	100,400	127,450
East Texas		441,650	439,600	474,450
Southwest Texas		238,800	239,900	264,700
Coastal Texas		222,000	213,400	221,750
TOTAL TEXAS	1,398,600	1,387,300	1,392,150	1,510,000
North Louisiana		78,350	82,500	88,950
Coastal Louisiana		188,100	186,950	176,150
TOT. LOUISIANA	255,300	266,450	269,450	265,100
Arkansas	53,700	56,900	57,100	36,300
Eastern	149,300	169,300	142,400	140,800
Michigan	57,000	49,700	51,100	48,550
Wyoming	65,600	50,850	58,000	54,200
Montana	14,000	12,650	13,850	17,850
Color do	4,600	3,600	3,700	4,800
New Mexico	111,600	106,950	101,350	114,200
TOTAL EAST OF CALIFORNIA	2,806,000	2,697,300	2,665,700	3,023,850
California	638,300	651,800	650,700	668,700
TOTAL U. S.	3,444,300	3,349,100	3,316,400	3,632,550

[1]These are Bureau of Mines' calculations of the demand for domestic crude oil based upon certain premises outlined in its detailed forecast for the month of September. As demand may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil stocks must be deducted from the Bureau's estimate of demand to determine the amount of new crude oil to be produced.



OUT IN FRONT . . . with a Balanced Personnel

When you buy acidizing you should buy knowledge, experience and performance and not acid alone. The acid or other materials used, while important, are only a means to an end—increased production.

What counts most is how much the organization employed *knows* about acid treatments from every angle and for *your wells*.

This is Dowell's great advantage—the prime reason it serves the big majority of producers. In its ranks are chemists and technicians who have to their combined credit every major contribution to the whole process of acidizing.

There are geologists of national reputation. And there are practical oil men who know the hard side of oil.

Dowell is "out in front" because it deserves to be there. It has won the respect and confidence of the industry because it offers brains with its materials.

DOWELL SUSTAINED ACTION ACID

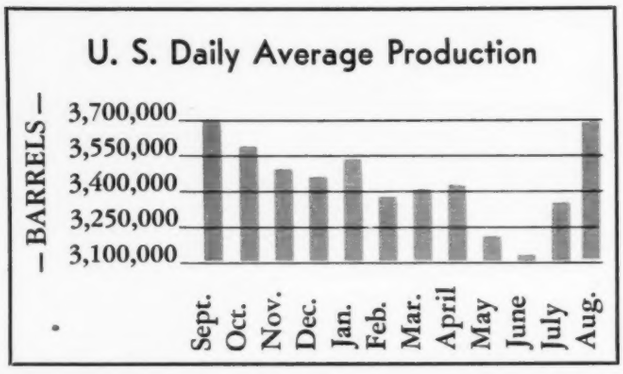
Dowell's latest achievement—a new principle of acid action. Dowell "XR" Acid is kept active till it travels far into the pay zone. Get the facts on Dowell "XR" from any Dowell office. There is no price premium for this new acid. It is offered where applicable at the same price as the famous Dowell "X".

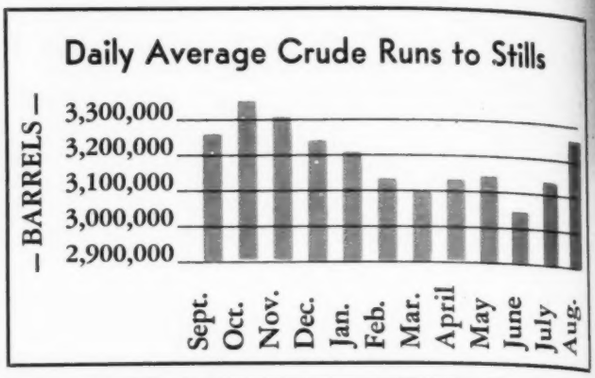
DOWELL

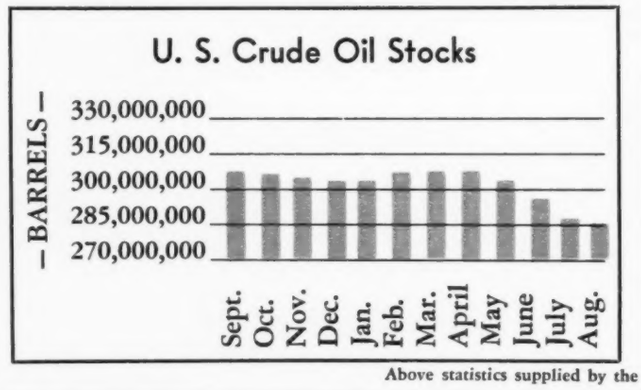
DOWELL INCORPORATED
Subsidiary of THE DOW CHEMICAL COMPANY
Executive Office: MIDLAND, MICHIGAN
General Office: KENNEDY BUILDING, TULSA, OKLA.

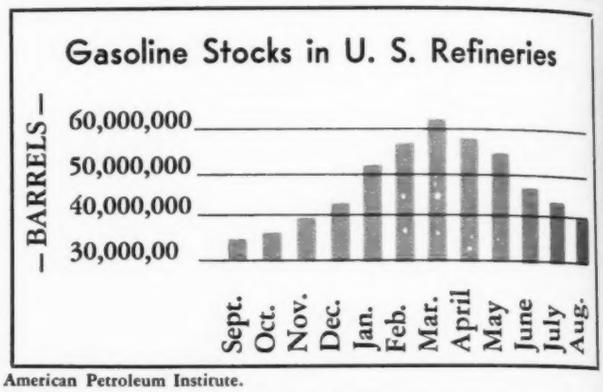
OIL AND GAS WELL CHEMICAL SERVICE

Summary of Petroleum Statistics and Field Activities









Above statistics supplied by the American Petroleum Institute.

Summarized Operations in Active Fields for August, 1938

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
Texas								
East Texas	124	120	23	39	3500-3700	2	40	Rotary
Duval County	49	43	6	17	1554-2900	2	22	Rotary
Ector County	43	42	9	69	3675-4377	2 and 3	32-36	Rot.-Cab.
Panhandle	39	38	36	129	1700-3900	2	40	Rotary
Refugio County	25	24	3	15	4900-5900	2	38	Rotary
Nueces County	32	30	8	25	3922-5878	2 or 3	21-54	Rotary
Winkler County	13	13	7	13	2850-3450	2 and 3	30-38	Rot.-Cab.
Talco Field	6	6	1	3	4230-4361	2	16-24	Rotary
K. M. A. Field	117	112	58	101	3730-3935	2	42-43	Rot.-Cab.
Oklahoma								
Oklahoma City	5	3	5	9	6450-6682	3	39	Rotary
Fitts Pool	21	15	2	7	1800-4488	2 or 3	38	Rotary
Kansas								
Russell County	15	15	3	19	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	18	11	4	16	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	23	21	6	20	3290-3518	2	39-42	Rot.-Cab.
Louisiana-Texas-Arkansas								
Rodessa	8	8	2	11	5950-6450	3	39	Rotary
Illinois								
Central Illinois	227	173	37	271	2950-4100	2	36-38	Rot.-Cab.
New Mexico								
Lea County	52	47	11	80	3150-4030	3	30-34	Rot.-Cab.
California								
Kettleman Hills	3	3	2	13	8300-8730	3 or 4	40	Rotary
Wilmington	27	27	13	23	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for August, 1938

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1937 (In Barrels)
	Aug.	July	Aug.	July	Aug.	July	Aug.	July	Aug.	July	
Arkansas	18	16	14	16	19	37	16	22	35	43	12,088,341
California	121	118	99	106	74	107	107	85	230	219	238,587,663
Colorado	....	....	....	....	....	....	2	1	24	27	1,532,893
Illinois	227	176	173	136	....	....	152	**150	84	82	7,376,022
Indiana	9	15	2	8	....	....	4	2	35	30	820,000
Kansas	135	116	98	76	145	128	36	28	200	189	70,542,000
Kentucky	78	83	62	56	....	....	9	10	102	99	5,500,000
Louisiana	100	93	66	70	110	151	47	57	203	219	90,501,068
Michigan	95	78	46	49	92	81	24	26	129	132	16,254,181
Mississippi	....	1	....	0	....	....	4	3	5	3	Gas Prod.
Montana	11	9	11	9	....	....	4	3	59	52	5,775,000
New Mexico	56	32	49	28	....	....	15	12	136	150	38,642,184
New York	43*	43*	41	32	....	....	....	....	....	....	5,466,200
Ohio	85	91	56	63	....	....	45	45	148	125	3,547,600
Oklahoma	162	197	108	113	162	195	59	36	290	289	225,402,731
Pennsylvania	165*	167*	157	161	....	....	....	....	....	....	19,154,400
Texas	1040	1068	803	831	1037	1067	357	375	1207	1245	506,891,233
West Virginia	56	49	46	40	....	....	24	19	119	99	3,833,000
Wyoming	9	15	6	9	....	....	6	3	56	67	19,402,121
Total	2410	2367	1837	1803	1639	1766	911	877	3062	3070	1,271,316,637

*Include water-intake and pressure wells.
**Include 115 rigs standing and 35 rigging up.

MODERNIZE YOUR RIG!

WITH THE **GUMBO BUSTER** (JOHNSTON)

ROTARY DRIVE TRANSMISSION

Provides 6 speeds to the Rotary Table, with engines compounded and run at proper speed for efficient pump operation.

FOR USE WITH ANY TWO OR THREE SPEED ROTARY DRAW WORKS

This Transmission is designed for use with Mechanical Drilling Rigs equipped with Reverse Clutch, conventional type Draw Works and internal combustion Engines which are compounded and run at constant speed during the drilling operation.

With the conventional type hook-up, the Rotary Table can be turned at only a limited number of speeds, unless the speed of the engines are varied. This Transmission supplies the required number of speeds to the Rotary for efficient drilling, while operating the compounded engines at their recommended maximum speed for developing sufficient horsepower for operating the pump at the proper speed and pressure.

When the Transmission is used, six possible speeds are provided for the Rotary Table without varying the speed of the Engines. This permits the use of any Rotary speed required for coring, hard or soft formation drilling, etc., while operating Engines and Pump at their most efficient and economical speeds.

The Transmission is of ample size to be used with the largest Mechanical Rotaries. It will transmit a maximum of 200 h. p. at 300 r. p. m. For detailed specifications, price, etc., ask for Bulletin No. 120.

Manufactured by **THE AMERICAN WELL & PROSPECTING COMPANY**
Corsicana, Texas

Distributed by

BRIDGEPORT

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Factory and General Offices, Wichita, Kansas

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WICHITA L. D. 59 and 116 Local 2-1431 and 2-1432
AND BRANCH STORES

Progress of Major Pipe Line Work

CONSTRUCTION of the Continental Oil Company's Lance Creek, Wyoming, to Denver, Colorado, pipe line will be completed about November 1st, it has been announced from company headquarters at Ponca City, Oklahoma. Work on the Lance Creek-Glenrock line will begin soon.

The Lance Creek-Denver line is being constructed in two units, the S. D. Bechtel Company laying the 8-in. line from Lance Creek to Cheyenne, and the Osage Construction Company the 6-in. line from Cheyenne to Denver.

Pumping stations will be constructed at Lance Creek and Cheyenne and at Denver a terminal will be provided.

●

The Texas Pipe Line Company has announced it will lay an 80-mile pipe line from the new Salem pool, Marion County, Illinois, to The Texas Company's refinery at Lawrenceville. Sixty miles of the new line will be of 8-in. pipe and from Salem will run in a southeasterly direction, also serving a pool The Texas Company opened recently in Wayne County. The last 20 miles of the line will be of 10-in. pipe.

●

France, in October, will begin construction of the longest pipe line in Europe, it has been announced, as the first major step toward eliminating danger of a gasoline shortage in time of war. The line will extend from the port of Dongas near the naval base of St. Nazaire, at the mouth of the Loire River, 300 miles into the interior, terminating at Montargis. It is expected to be completed within a year.

The project will cost about $7,500,000. The line will have its right-of-way through the Loire Valley and will transport gasoline and lubricating oils to Montargis whence they will be transported to Paris and other important centers by canal.

●

The Oklahoma Pipe Line Company placed in operation early this month a gathering system to serve the Beecher City, or Loudon pool, of Fayette County, Illinois. Crude oil is being delivered from the pool to the Illinois Pipe Line Company's Brownstown station near Vandalia.

The system consists of the Loudon pumping station about 18 miles west of Effingham from which a 10-mile welded 6-in. line will transport oil to a 10,000-bbl. tank at the Brownstown station. The pumps at the Loudon station are Diesel driven.

An 8-in. welded gathering line, about six miles in length, extends through the field north and east of the Loudon station. Screw-coupled 4-in. laterals connect the main gathering line with tank batteries. The system will be enlarged as the field requires a greater outlet, it is stated.

●

The Great Lakes Pipe Line Company has completed the laying of a 55-mile, 6-in. gasoline line from Ponca City to Barnsdall, Oklahoma. Kelly-Dempsey and Company, Tulsa, Oklahoma, were the general contractors and the job was completed in 28 days. The H. C. Price Company, Bartlesville, Oklahoma, had the contract for electric welding the line.

●

Capertree Petroleum Pty., Ltd., recently formed, has signed an agreement with V. V. Jacomini of Houston, Texas, representing a group of American firms, for the laying of a 140-mile pipe line from the oil shale district of Baerami to Sydney, Australia, where a refinery will be erected. The project will be financed by American capital, it is stated.

The Standard Oil Company of Australia, Ltd., owns leases in the oil-shale area of the Baerami district and Capertree Petroleum Pty., Ltd., intends to acquire concessions in the oil-shale deposits in the district. These two companies and a third, believed to comprise a group of United States pipe line equipment suppliers, are coöperating. The latter will finance the project, lay the line, and operate it for a time, after which it will be taken over by an Australian company.

●

The San Joaquin Light and Power Company, subsidiary of the Pacific Gas and Electric Company, is laying an 8-in. pipe line from Merced to Livingston, California, a distance of 14 miles. The line will transport natural gas to Merced and Livingston.

The Pacific Gas and Electric Company also has announced the construction of a 10-in. line nine miles in length to parallel a 6-in. gas line between Davis and a point nine miles to the south. This is a part of the Rio Vista project, most of which was completed about a year ago, to supply towns north and east of the San Francisco Bay area with gas from the Rio Vista field.

Lindgren and Swinerton, Inc., San Francisco, are the general contractors for the 10-in. line, and the H. C. Price Company, Bartlesville, Oklahoma, has been sub-let the contract for the electric welding.

●

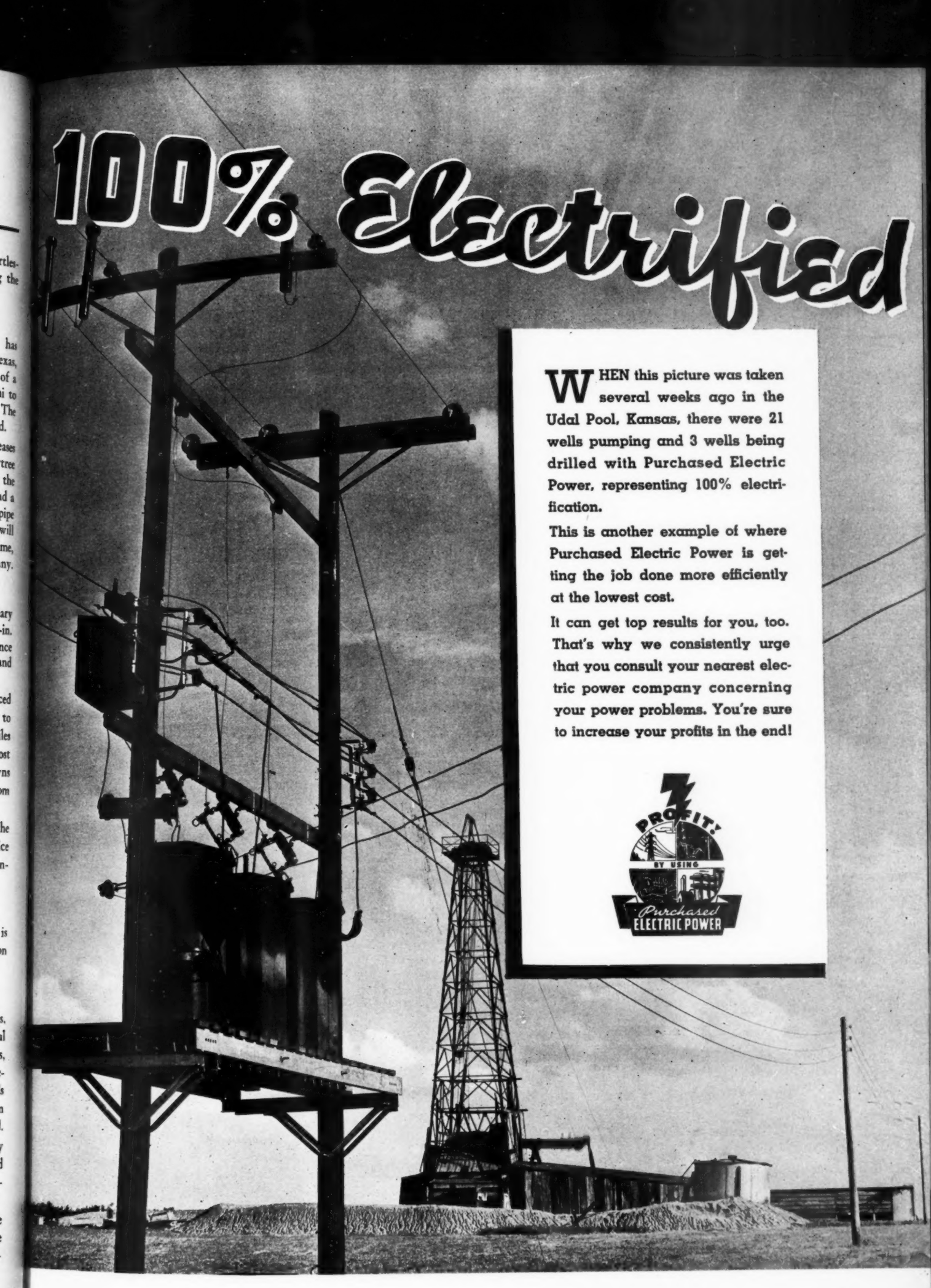
The Atlas Pipe Line Company, Shreveport, Louisiana, is laying a 6-in. pipe line from its Gillark station to the Cotton Valley field, Louisiana, a distance of 12 miles.

●

Hagy, Harrington and Marsh Company, Amarillo, Texas, operators, has announced plans for the laying of a natural gas pipe line from the Hugoton field, southwestern Kansas, to steel mills in the Mesabi mountains of northeastern Minnesota. In addition to supplying gas to the steel mills, laterals will be laid connecting the trunk line with 129 towns in Kansas, Nebraska, South Dakota, and Minnesota, it is asserted.

Laying of the line, which engineers of the company say would transport 100,000,000 cu. ft. of gas per day, would necessitate the drilling of about 100 new wells in the Hugoton field, it is stated.

The company has applied to the Reconstruction Finance Corporation for a loan of $20,000,000 to help finance the project and private capitalists will advance another $5,000,000, it is stated.



WHEN this picture was taken several weeks ago in the Udal Pool, Kansas, there were 21 wells pumping and 3 wells being drilled with Purchased Electric Power, representing 100% electrification.

This is another example of where Purchased Electric Power is getting the job done more efficiently at the lowest cost.

It can get top results for you, too. That's why we consistently urge that you consult your nearest electric power company concerning your power problems. You're sure to increase your profits in the end!

PROFIT BY USING Purchased ELECTRIC POWER

PETROLEUM ELECTRIC POWER CLUB

The Month's Activities in Refining

Percent Refining Capacity Operated

Western Division, 74.1 Percent **Central Division, 79.6 Percent** **Eastern Division, 81.3 Percent**

THE construction program initiated by the Shell Oil Company two years ago to enlarge and modernize the lubricating oil manufacturing facilities at its Martinez refinery in California has been completed. The project involved the expenditure of more than $1,000,000.

The first step consisted of the construction of two new distilling units for the manufacture of lubricating distillate from crude. The units process 10,000 to 15,000 bbl. per day, depending on the type of lubricating crude charge.

The second part of the program consisted of the construction of a solvent extraction plant of an improved type to refine these distillates. This plant marked the completion of Shell's modern lubricating oil plant. The solvent extraction unit employs furfural as the selective solvent and treats a maximum of 126,000 gal. of distillate per day.

●

Completion of a $3,000,000 initial program to expand and make more flexible its manufacturing facilities has been announced by Union Oil Company of California. Extensive additions and alterations have been made to its refineries at Wilmington, adjacent to Los Angeles Harbor, and at Oleum, across the bay from San Francisco.

After exhaustive research tests, the company now is proceeding with construction of additional solvent extraction plant facilities, which will double the capacity for manufacturing its highest quality lubricating oil.

At the Oleum refinery, the company recently placed in operation a new unit for cracking heavy oils. Daily throughput capacity of this unit is estimated at 14,000 bbl., and the per-day yield is about 5000 bbl. of finished gasoline, 7000 bbl. of fuel oil, and 3,000,000 cu. ft. of gas.

A new crude distillation unit also was constructed at Oleum to replace a 10,000-bbl. plant. This new unit has a daily throughput capacity of 15,000 barrels.

A $5,000,000 steam and electric generating plant will be constructed adjacent to the refinery.

A major item in the Wilmington refinery development was the rearrangement of air-blown asphalt facilities and the enlargement of the steam-blown asphalt plant to improve the quality of the product and to increase capacity. In addition, several new refining units were installed to increase the output of the specialties manufactured for industrial firms.

●

Universal Oil Products Company has just announced a reduction of five cents a bbl. throughput for Dubbscracking, thus cutting the present rate of ten cents a bbl. in half. Substantial reductions likewise are being made in the rates for reforming and viscosity-breaking operations.

The new rates, which take effect October 1, apply only to refiners, some 60 in number, using the process in the United States.

This is the second major royalty reduction made by Universal and it brings the rate to one-third of what it was in the beginning. When the first commercial Dubbscracking unit was put in operation in 1919, the royalty was 15 cents a bbl. and the yield of gasoline guaranteed by Universal was 21 percent. Today, many refiners are getting yields of 60 percent or considerably better from their Dubbscracking operations, it is asserted.

●

Gasoline Products Company, licensor for many years of the Cross, Holmes-Manly, and DeFlorez cracking processes and more recently, with its licensing agent, The M. W. Kellogg Company, originator of the modern "Combination" and "Unicoil" process, announces reductions in the royalty rates for its various processes for the United States and Canada. Effective October 1, 1938, the rates based on fresh charge to regular cracking units will be five cents per bbl. for "defense and hold harmless" and four cents per bbl. for "defense only." Rates based on gasoline produced will be proportionately reduced, and paid-up rates will also be subject to reductions. Special rates for reforming will be continued.

●

Preliminary plans have been completed by engineers of the Consolidated Refineries, Ltd., for the construction of a refinery in the Haifa Bay area, Iraq. A railway siding will be laid from the Haifa-Acre line to the refinery site to facilitate the transportation of materials to the refinery site direct from Haifa Harbor. The project is being sponsored by Anglo-Iranian and Shell interests.

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks
Week Ended September 3, 1938

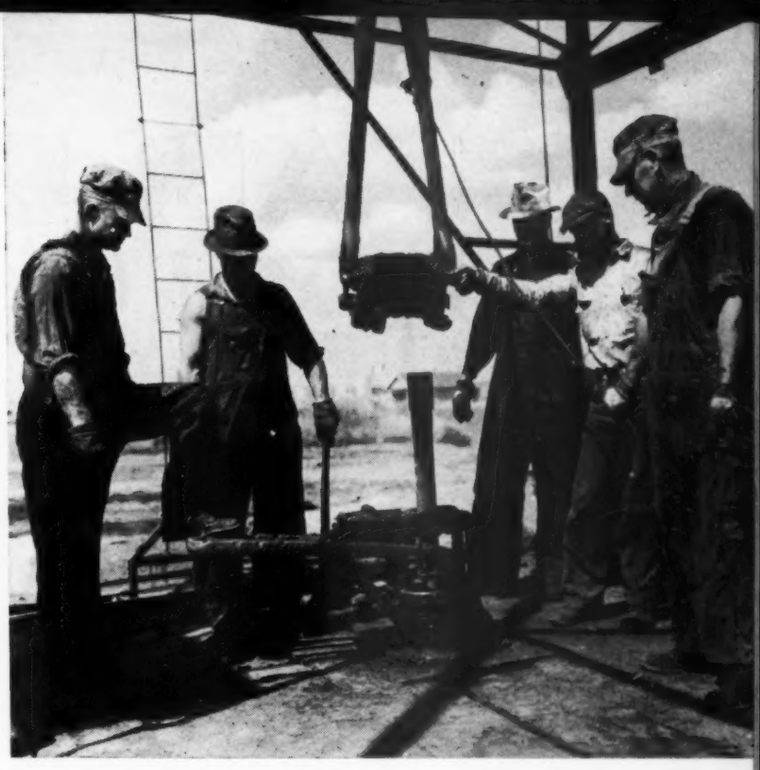
A. P. I. Figures

(Figures in Barrels of 42 Gal. Each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks Thousands of Bbl.	Gas and Fuel Oil Stocks Thousands of Bbl.
East Coast	100.0	506,000	82.3	19,627	14,660
Appalachian	85.9	102,000	79.7	3,081	991
Ind., Ill., Ky.	89.0	398,000	81.9	10,638	9,375
Okla., Kans., Mo.	81.6	270,000	78.9	6,332	4,381
Inland Texas	50.3	112,000	70.4	1,716	1,929
Texas Gulf	88.9	772,000	92.1	10,098	13,549
La. Gulf	97.1	119,000	87.5	2,126	3,261
No. La. & Ark.	55.0	38,000	69.1	488	866
Rocky Mt.	54.2	51,000	79.7	1,241	838
California	90.0	510,000	68.5	11,627	94,796
Reported	85.5	2,878,000	80.7	66,974	144,646
Estimated Unreported	.....	317,000	.....	3,540	3,000
*EST'D TOTAL U. S. SEPT. 3, '38	.....	3,195,000	.....	70,514	147,646
*EST'D TOTAL U. S. AUG. 27, '38	.....	3,255,000	.....	71,754	146,926
U. S. B. of M. *SEPT. 3, 1937	.....	**3,450,000	.....	66,618	112,737

*Estimated Bureau of Mines' basis.
**September, 1937, daily average.

Adjusting Guide Head. The patented Guide Head of the Guiberson Spider guides the tubing to the exact center of the hole, insuring accurate seating of slips



Removing Elevator. Tubing is safe in this spider's grip. The men are: T. W. Wade, John Spence, Jack Sims, Clyde Smith (Toolpusher), and E. I. Caruthers

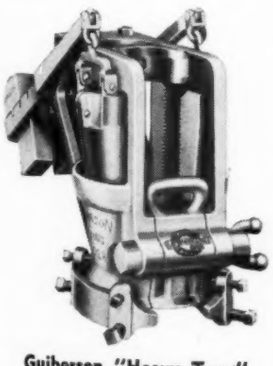
"THAT GUIDE HEAD IS A WONDERFUL IMPROVEMENT", SAYS CLYDE SMITH

CLYDE SMITH, fourth from left, second picture, in the employ of a major oil company, at Edmond, Oklahoma, tells us that the patented "Guide Head" on the Guiberson Tubing Spider is a wonderful improvement in spider design. This exclusive patented device is so adjusted that it holds the tubing in exact center of the spider's bore, at all times, whether running or pulling — causing the spider slips to seat instantly and accurately around the tubing without handling or forcing by the men. The men's hands need not be placed near the slips.

"We don't drop tubing with this spider," Smith added, "and it's the only spider we ever used that won't slip in paraffin."

This new-day spider offers other outstanding and exclusive advantages, which render it as nearly automatic as a spider can be. The lever seats or retracts the slips at one motion of the hand or foot of the operator. It can be used with or without the adjustable weight. A safety latch holds the lever in raised position and the slips in bowl, preventing slips from being thrown from the bowl should the tubing rebound. Large opening through spider body passes tubing catcher, packer or other tools. It is quickly installed or removed by simply removing bolt and gate.

Made in two sizes. See it at your supply store. The Guiberson Corporation, Box 1106, Dallas, Texas.



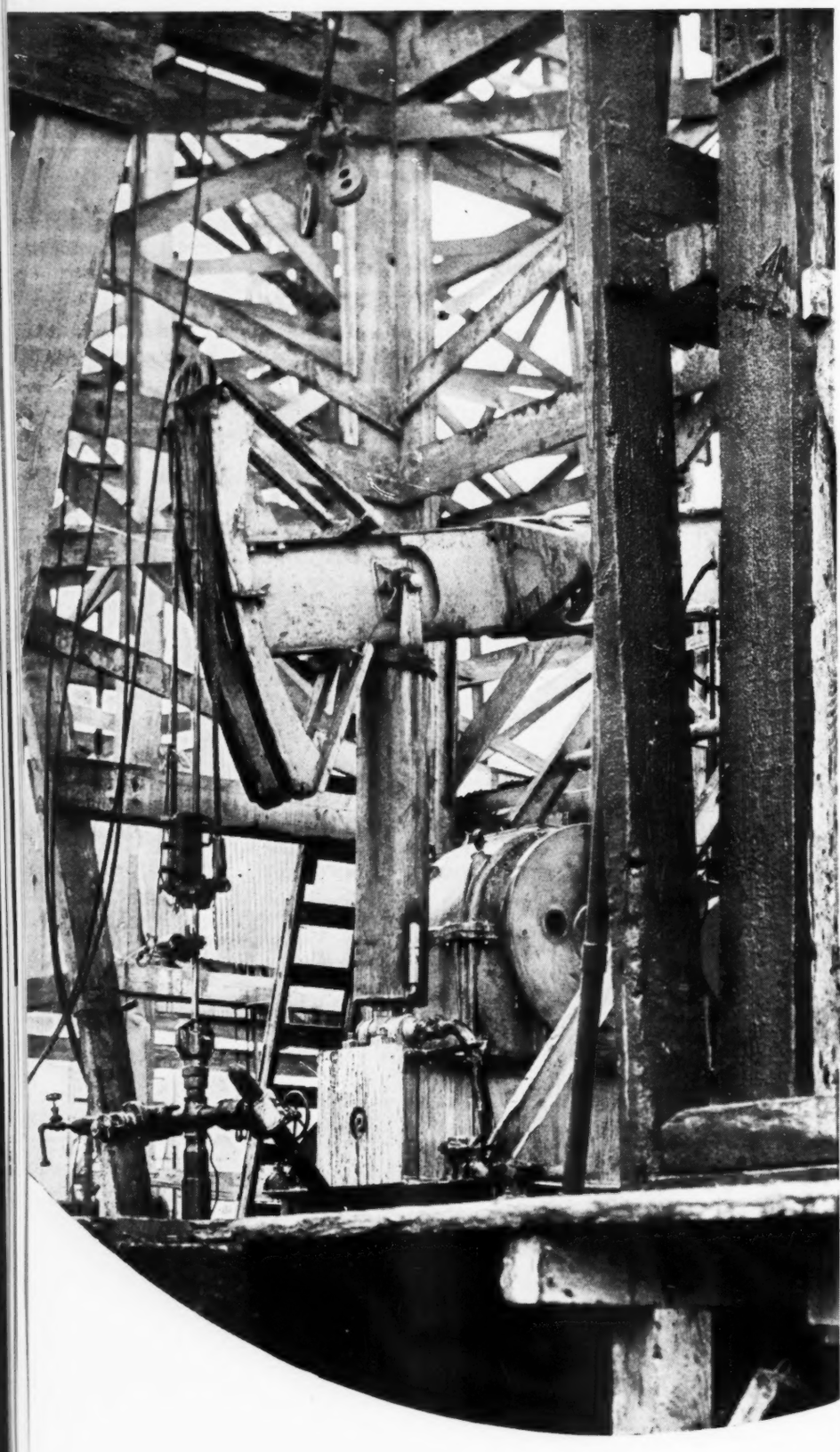
Guiberson "Heavy Type" Tubing Spider

Making Up. No back-up wrench is needed. Spider's grip is plenty powerful

Running In. (below) Slips retracted by lever. Men stand at safe distance

This AIR BALANCED

PUMPING UNIT INCREASED PRODUCTION



200 BARRELS PER DA
AND REDUCED
ROD BREAKAGE TO
RATIO OF 4 TO

Use the

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AIR BALANCED PUMPING UNI

AND

LOWER YOUR LIFTING COST PER BARREL

REED ROLLER BIT COMPANY

P. O. DRAWER 2119, HOUSTON, TEXAS

THE Petroleum Engineer

SEPTEMBER, 1938

Valve System Designed to Aid Production From Different Zones in Small Gas Wells

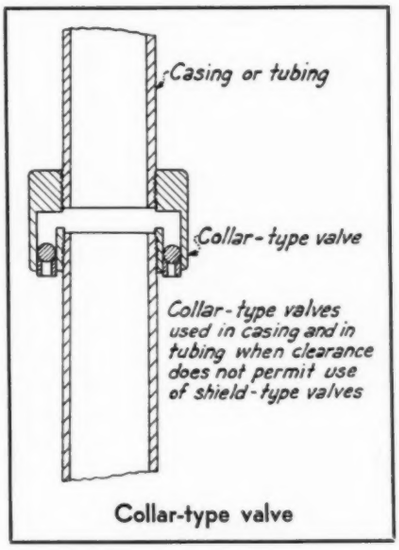
Valve opposite each formation opens automatically when well pressure declines below formation pressure of that zone

By ED ORR

IN the high hill country of central West Virginia many gas properties are situated on mountain sides and in remote coves. Caring for wells on these properties is expensive. Many of the wells produce but little gas and are constantly threatened by the sub-surface encroachment of oil and water. The life of many such wells can be extended and the gas production increased by proper control of oil and water encroachment. Hundreds of such wells in West Virginia have been abandoned and any possible means of salvaging them interests the operators. A valve system invented by Alex Villers, of Weston, an employee of the Pittsburgh and West Virginia Gas Company, has been installed in several wells of doubtful economic value in this section of the Appalachian region, and is reported to be successful in reviving the production of gas.

The complete valve system consists of valves of two types: the shield type and the mandrel or ball type, but the shield-type valve can be used separately under certain conditions.

When the complete valve system is installed in a well, the mandrel or ball valve is placed on the bottom of the tubing, and the shield valves are placed at various points opposite each producing sand between the tubing and perforated casing.


Casing or tubing
Collar-type valve
Collar-type valves used in casing and in tubing when clearance does not permit use of shield-type valves

Collar-type valve

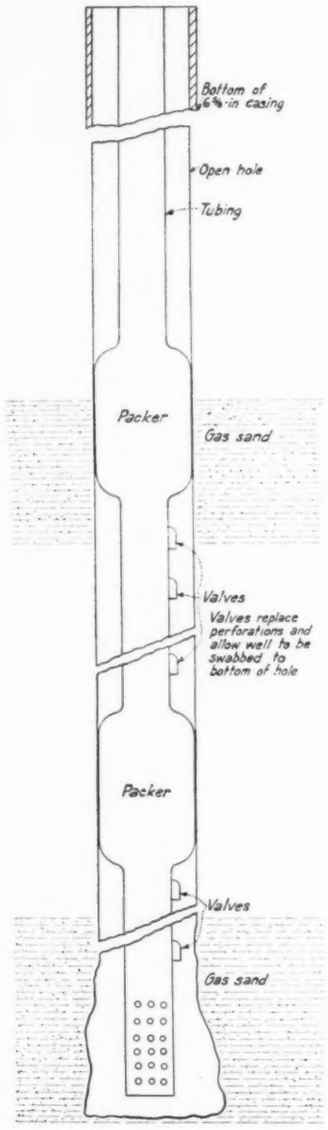
The shield-type valves, when used between perforated casing and tubing, allow any liquid in the gas to enter the tubing where it can be swabbed or blown from the well. The use of the valves here eliminates the need of the ¾-in. siphon system and also allows tubing to be used instead of 5-in. casing. Tubing can be swabbed more quickly than 5-in. casing can be bailed.

If an oil sand is found above the gas sand, a valve may be introduced through which the oil may be pumped or swabbed, the gas pressure holding the valve closed and keeping the oil outside the tubing until it is to be produced.

Substituting a shield valve for perforated tubing opposite the lowest gas sand allows the well to be swabbed to bottom. The collar valve works on the same principle as the shield valve, and it is used if the clearance is insufficient to permit use of the shield-type valve.

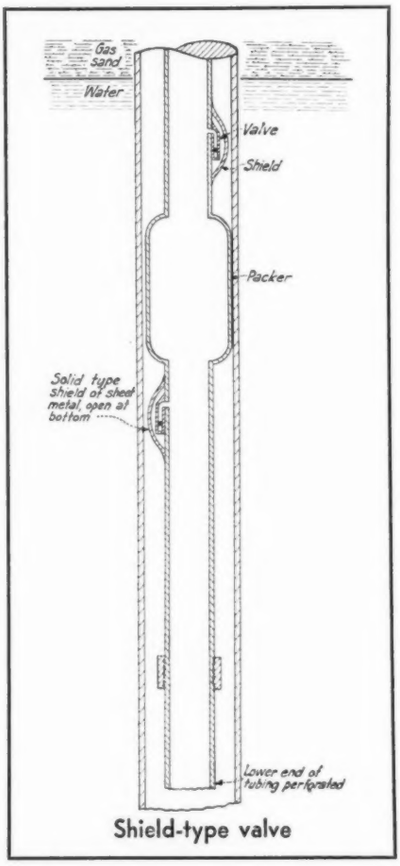
The mandrel or ball valve operates the entire system. The ball valve opens automatically when the pressure in the sand builds-up; the pressure will raise the ball and allow gas and liquid to

Sketch showing use of shield valve in well



flow into the tubing. If the pressure drops, the valve closes.

The mandrel-type valve does the same work but is opened and shut by tools from the top of the hole.



Shield-type valve

The use of the valve systems gives the following advantages:

1. Each gas sand can produce separately and will deliver its gas when the well pressure is reduced to the rock pressure of the individual sand.

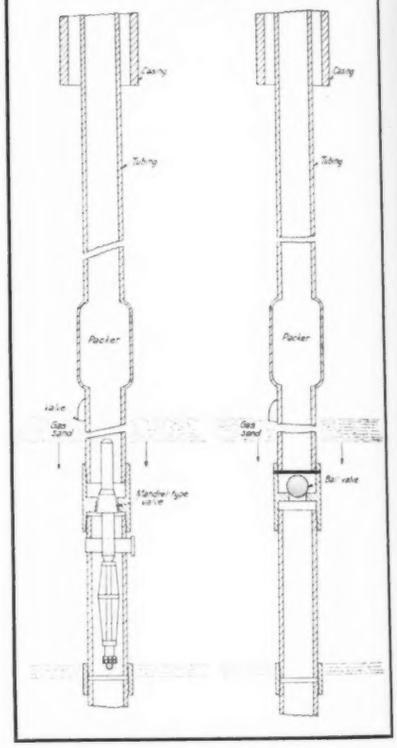
2. If offset wells are producing under vacuum, the valve system prevents the sands from being "pulled," and maintains the line pressure if the check valves do not hold. If vacuum is applied to a sand, the ball on the shield-type valve is closed, and gas can pass up the hole from other sands.

3. The oil or water is held in the tubing and the tubing can be swabbed dry to the bottom of the hole.

4. The mandrel-type valve can be used to operate the siphon system.

The system is expected to offer a means of salvaging many small gas wells in the mountains of West Virginia, where scattered small properties are so bothered by water and oil that many wells already have been plugged.

Left—Mandrel-type valve
Right—Ball-type valve



Bureau of Mines Reports on Motor Gasolines

GASOLINES in the various price classifications fall into definite groups with regard to octane rating, distillation range, vapor pressure, and other characteristics, according to a survey report for the winter of 1937-38, issued by the U. S. Bureau of Mines.

Gasoline survey reports are made semi-annually by the Bureau of Mines to give information as to the quality of gasolines sold generally throughout the United States. This information is desired by automobile designers to enable them to provide the best engines possible to take advantage of the characteristics given to the gasolines by the skill of the refiners. The reports also supplement surveys made by individual petroleum refiners who need to know the characteristics of gasolines being made by all other refiners so they can manufacture a product within the limits of uniformity required for satisfactory engine operation.

For more than 20 years the Bureau of Mines has reported periodically on analyses of gasolines sold to the general public at service stations throughout the United States. Recently these surveys have been made in coöperation with the Coöperative Fuel Research Committee, which is a joint activity of the Society of Automotive Engineers, the American Petroleum Institute, the Automobile Manufacturers' Association, and the National Bureau of Standards. The paper just issued in this series, Report of Investigations 3408, Coöperative Fuel Research Motor Gasoline Survey, Winter, 1937-38, compiled by E. C. Lane, may be obtained without cost from the Bureau of Mines, Information Division, Washington, D. C.

Metals Used in Pipe Line Construction and Operation*

Discussion gives clearer conception of problems confronting pipe line engineers, many of which may be solved by proper application of special metals and alloys

Part 1

By LEWIS F. SCHERER

Assistant Chief Engineer, The Texas Pipe Line Company

THE subject of this paper is of such broad scope that it will not be possible to enter into any detailed discussion of individual examples. Perhaps in no other industry is the engineer required to have intimate contact with such a wide variety of materials as in the pipe-line industry. Being of necessity a "jack of all trades" he seldom has the capacity or the time to be a master of any one, but must rely to a considerable extent upon practical experience. In addition to this, the rapid growth of the industry within the past few years has precluded the maintenance of adequate test records. In order to have a clearer picture of some of the problems involved, it might be well to describe briefly the plan and operation of a pipe line system.

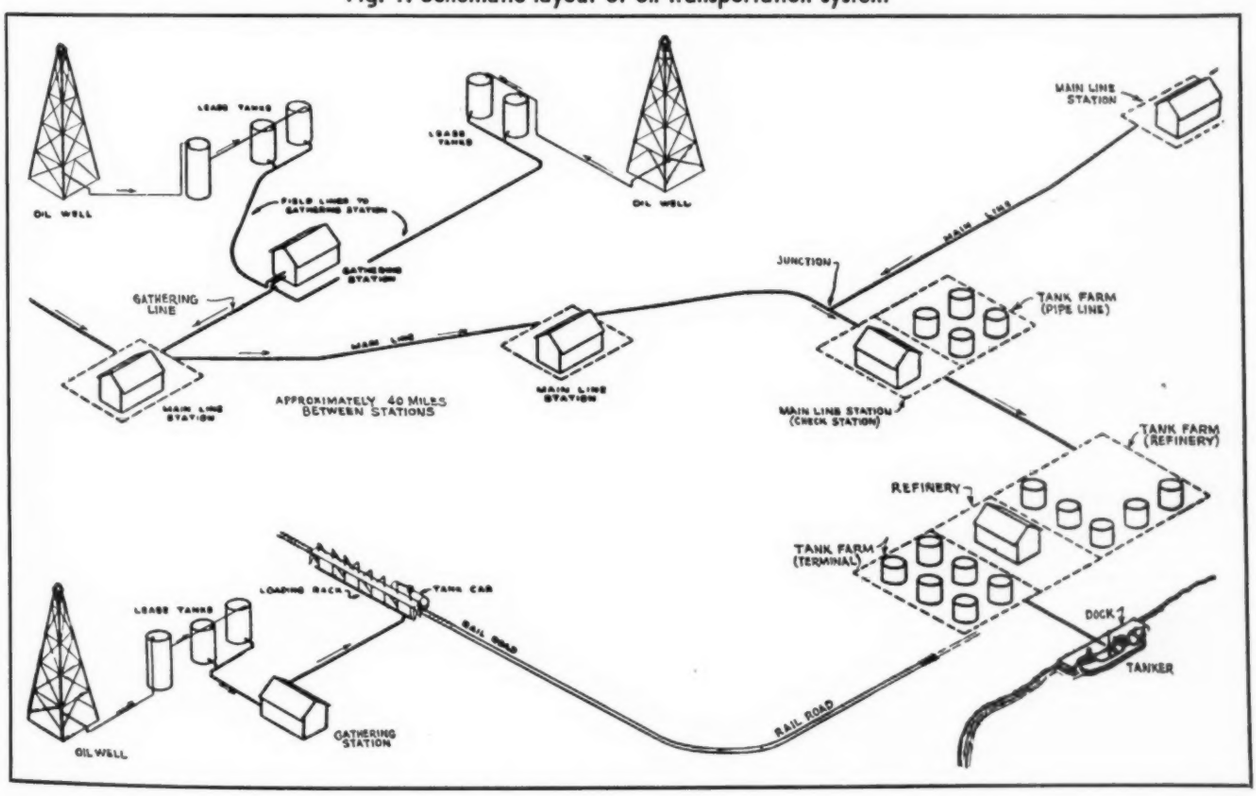
*Paper presented at the Western Metal Congress, Los Angeles, California, March, 1938.

Pipe Lines and Their Operation

The modern pipe-line system has often been called an underground railroad, and, in many respects, it is similar to a railroad with its branch lines, freight yards (tank farms), main lines, depots (booster stations), telephone systems, methods of dispatching, and accounting. The pipe line is essential to maintenance of an uninterrupted flow of petroleum products from the oil fields to the refineries and consumers through more than 280,000 miles of pipe buried beneath the surface of the ground, unknown to the layman, yet providing safe and continuous service to almost all important centers of population in the United States.

In a crude oil pipe-line system the main trunk line consists of one or more lines of pipe, extending from center of production to point of delivery, which may be a refinery, marine terminal, or railroad loading rack. At

Fig. 1. Schematic layout of oil transportation system



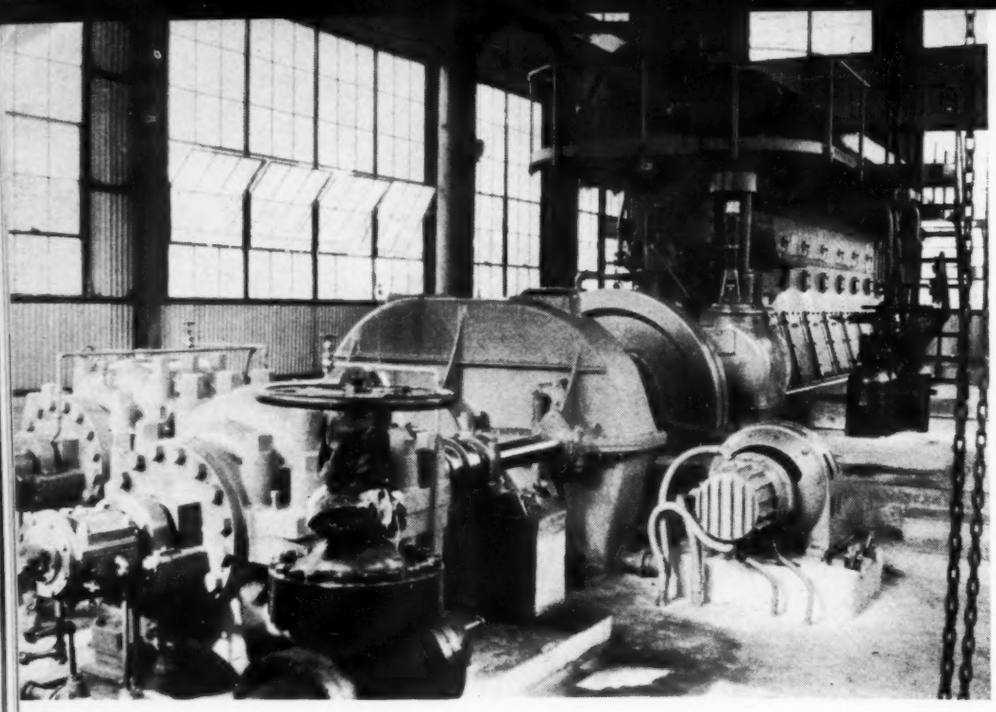


Fig. 2. Modern pipe line pumping unit

suitable points along this line are pumping stations that repressure the stream of oil, forcing it through the line to the next station. These stations are usually spaced a distance of 40 miles, although this may vary, depending upon the terrain and the viscosity of the oil. A schematic layout of such a system is shown in Fig. 1.

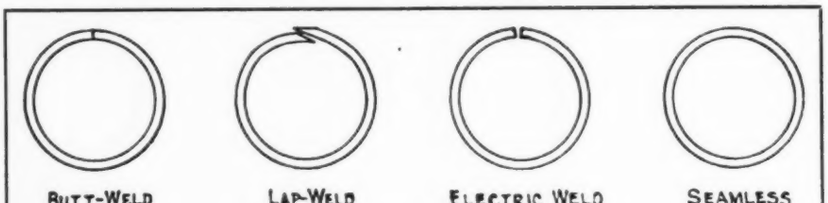


Fig. 3. Method of forming various types of line pipe

The main line stations, which repressure the oil, consist of the proper capacity of Diesel, steam, motor, or gas engine driven pumps of either the reciprocating or centrifugal type. The operation and maintenance of this equipment is unique in that the "load factor" of pipe line equipment is usually much greater than for other service. "Standby" equipment available for use during repairs is limited, and the locations of the stations are usually so remote as to preclude the possibility of obtaining the advantages of modern machine shops or materials for repairs.

The first successful pipe line was built in 1865 and consisted of five miles of 2-in. wrought-iron pipe. The growth of pipe-line systems and technique was steady from that time onward, but it has only been during the last 25 years that this growth and development has assumed tremendous proportions. The introduction of the art of welding the pipe joints into a line of any length, first successfully accomplished in 1919, presaged the rapid technical development during the last two decades.

The largest single investment carried on the books of a pipe-line company is the line pipe. Transportation of fluids by tube is as old as history, but the manufacture and use of the steel tube as known today is relatively new and the strides made in manufacturing methods during the last ten years have been great.

Manufacture of Line Pipe

All steel pipe used in pipe lines will fall under one of four general manufacturing classifications; namely, butt weld, lap weld, electric weld, and seamless. Fig. 3 shows the method of forming each type of pipe.

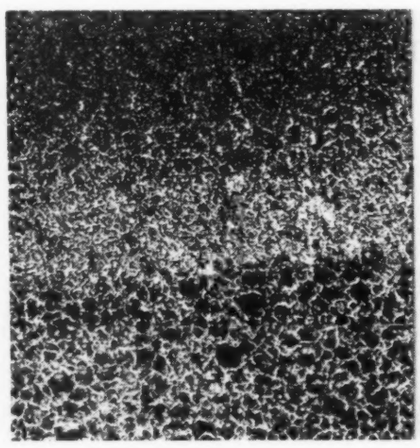
A butt-weld pipe is made from a hot rolled strip, with square or slightly beveled edges, called a skelp, the width of which corresponds to the circumference of the pipe, and the gauge to the desired thickness of the wall. The skelp is heated to the temperature at which a natural flux forms on the skelp in the furnace. It is then drawn through a suitable die while at this temperature, and the skelp is bent into cylindrical shape and its edges pressed firmly together into a butt weld, thus forming a pipe.

In the lap weld process, the hot rolled plate must be of a gauge corresponding to the thickness of the wall of the pipe desired but of an over-all width slightly greater than its circumference. The edges are scarfed, i.e., tapered, to form acute angles with the faces. Before welding, this scarfed plate is bent into cylindrical form while at a temperature of about 800 deg. fahr., with the scarfed edges overlapping so that a much larger surface for welding is provided than in the case of the butt weld. After being heated to a welding temperature, the lapped edges are welded together by passing over the mandrel between rolls.

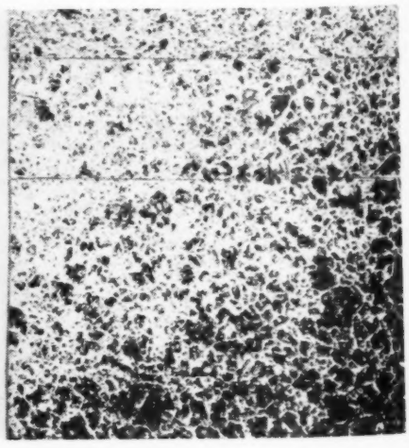
In the manufacture of electric-weld pipe, the plate gauge is of a thickness corresponding to the desired pipe wall. The plate is sheared to a width slightly less than the finished circumference. In some processes the edges are beveled slightly. The plate is then cold-formed in a suitable bending machine and delivered to the welding machine with the seam at the top. The welding ma-

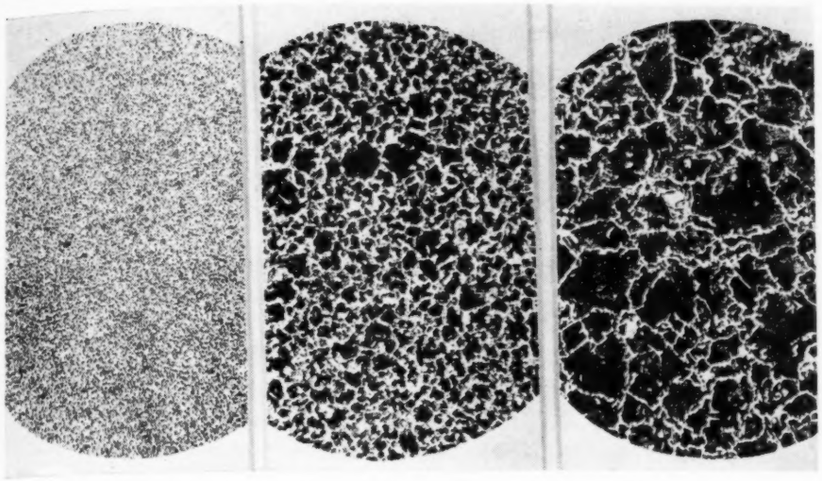
Fig. 4

Sample 1. Electric arc weld



Sample 2. Acetylene weld





A B C

Fig. 5

chine passes it through suitable electrodes, which weld the seam. This action is rapid and the welding heat permeates the material but a short distance. The pipe is then passed to the sizing and straightening rolls. Various means are used for making this longitudinal seam, such as fusion welding and shielded arc, but the final result is essentially the same.

Seamless pipe is made by two basic processes, known as the "piercing process" and the "cupping process." The piercing process, in which a solid round bar or billet is pierced and afterwards brought to the desired diameter and thickness, is generally employed in the manufacture of pipe of the usual pipeline sizes.

Stated simply, the process consists of forcing cylindrical billets of the proper diameter and length to make the size pipe desired, over a water-cooled mandrel or plug by means of diagonal rolls. The rolls revolve at a constant speed and the billet is pushed between the rolls, which grasp it, revolve it rapidly, and pull it slowly forward while at the same time they draw the metal away from the center to form a hole, and force the metal over the mandrel. When the billet issues from the mill it is in the form of a thick-walled tube. The billet is heated initially to 2150 deg. fahr. and working of the metal raises the temperature to approximately 2300 deg. fahrenheit. Present practice calls for it to be passed through another similar mill, which enlarges it somewhat before it is passed to the rolling mills.

The rolling mill consists of suitable concave-faced rolls that force the hot tube over a series of mandrels until it is brought to the proper size. The tube subjected to the action of the rolls on the outside and supported by the mandrel on the inside is reduced in thickness to the gauge desired and is proportionately lengthened and slightly reduced in outside diameter. Further processes bring the tube to exact size and straighten it.

Comparison of the Types of Pipe

Obviously this process results in a tube having none of the brittleness incident to cold working, of a fine and uniform grain structure, and slightly stronger than a full annealed tube made of the same steel. The constant working tends to eliminate or show up during processing any inclusions that may exist in the original billet.

Generally speaking, butt-welded pipe is no longer used for high-pressure pipe line work due to the inherent difficulty of obtaining uniformly a 100 percent joint. The surges and shocks encountered are such as to make this form of pipe construction unreliable.

Some of these difficulties are also inherent in lap-weld pipe because of gas pockets, scale, and inclusions, although because of the greater contact area, the pipe is more nearly uniform.

Electric-weld pipe, due to the cold working process of forming, has a higher ultimate strength and consequently higher working pressures can be carried with less wall thickness. Here again, however, we find that the joint is the weak point, for, although the mills thoroughly test each joint, it is possible for leaks to develop because of rough handling between the mill and destination. Inclusions, or gas pockets, forming pinholes undetected at time of test may show up after the line is in operation.

Due to the manner in which it is manufactured, seamless pipe is less likely to develop defects in service and may in general be considered a uniform product.

Choosing the Pipe for the Job

The limits for the physical and chemical properties of the steel used for line pipe are quite definitely established in the American Petroleum Institute's Specifications 5L for line pipe. There is, of course, some variation in price; however, if we compare the various types based on the same working pressure as calculated by Barlow's formula, using the allowable fibre stress, we will find that the cost per mile of each type of pipe will vary but little. The lap weld will be somewhat less expensive than either seamless or electric, but due to its lower allowable fibre stress it will of course be heavier. The higher freight, hauling, and handling cost will rapidly offset the slight price advantage. When everything is considered, the choice of the type of pipe to be used in a particular line becomes largely one of engineering economies based on service life required, class of service, availability, freight, and handling costs.

Pipe Line Welding

During the last ten years the welding of pipe joints into a continuous pipe line has become common practice. Both the acetylene and electric processes are used, but for most of the large construction projects the electric arc is more commonly used. Since the early days of pipe welding, tremendous strides have been made in the technique, but there is much still to be done.

All companies incorporate in their specifications certain definite welding practice and require qualified welders; however, the weld itself changes the grain structure and physical characteristics of the pipe metal adjacent to the weld and the welders themselves being human, make many welds that are now undetectably poor. Until some means is developed to permit detecting these poor welds by some simple inspection, the welded joint will continue to be the weak point in the line.

It is well known that the thermal changes brought about by welding result in a non-uniform condition in the grain structure of the metal. This is especially true for steels having a carbon content above 0.30, which makes it more sensible to heat treatment. The photomicrographs shown in Fig. 4 indicate the nature of these changes. The normal grain structure in the "as rolled" condition is indicated at the extreme left of samples 1 and 2.

The thermal effects of the electric

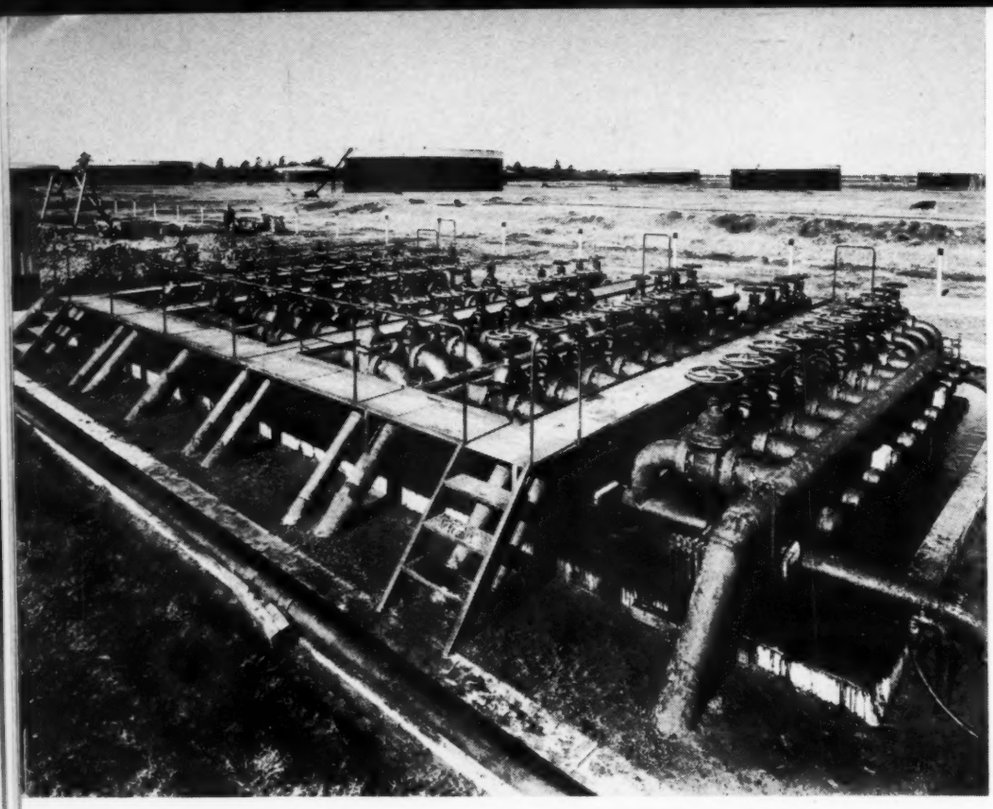


Fig. 6. Typical pipe line manifold

arc are indicated in sample 1 in which the grain structure varies from the fine texture adjacent to the weld to the original normal structure of the pipe within a relatively short distance. This variation in grain structure corresponds to respective heat treatments varying from a rapid quench in the area adjacent to the weld, to a normal draw in the original structure. This is more strikingly brought out by comparing the three photomicrographs of similar material in Fig. 4 with the corresponding areas in the samples in Fig. 5. "A" is a sample that has been water quenched, "B" is one that has been normalized, and "C" is one in the "as rolled" condition.

The action of the acetylene torch results in thermal effects that vary somewhat from those of the electric arc. This is indicated in sample 2 of Fig. 4. The grain structure indicates an annealed and possibly an overheated condition immediately adjacent to the weld and varies to the original structure. In the narrow area before transition to the original structure, there occurs a refinement of grain that is the effect of rapid cooling.

In either type of welding there is developed a non-uniform condition near the weld. Physical characteristics of increased strength, hardness, and embrittlement are obtained by a fine grain structure, but its incorporation in a pipe wall of normal grain structure must result in a concentration of applied stresses and as these are confined within the narrow limits adjacent to the weld, they are detrimental to the pipe. Coupons taken from butt-welded joints and tested for tensile strength and elongation, in general substantiate the above remarks.

Most pipe used in pipe lines has a carbon content of 0.30 or less. This is necessary largely because of the thermal effects of the weld, which would tend to nullify the admitted advantages to be received through the use of higher-carbon-content pipe. This thermal effect, of course, becomes much more pronounced as the carbon content increases. Tests of coupons taken across the butt welds of high-carbon pipe have shown that failure occurs almost invariably at a value lower than that of the original structure.

Where highly corrosive oil or salt water is handled in a pipe line, frequent use is made of cast-iron, wrought-iron, or copper-bearing steel pipe. However, this use is not at all general. The handling cost of cast-iron pipe makes its general use impractical, and the cost of wrought-iron and copper-bearing steel pipe retards the more general use of these products despite some decided advantages that might accrue through their use.

Other Forms of Pipe Joints

The art of welding has, of course, superseded the conventional pipe coupling except for field lines. Lately several patented types of coupling have come into fairly general use for short lines, for lines that are not expected to be in service long, and for field lines. These are a form of cast-steel, malleable-iron, or cast-iron clamps that fit in grooves on the end of the pipe, hold it with knurled hardened rollers, or by friction applied through packing. Their principal advantage so far as crude oil service is concerned, is the decreased cost of laying or recovering the pipe in the line. All of them depend upon holding the line pressure through the use of patented seal rings or packing.

Special Fittings

Screw type elbows, tees, etc., were, of course, largely replaced by welding. In welding practice, turns were made by sectioning the pipe at 45 deg. to its axis and welding the cuts together to form a 90-deg. angle. On better jobs a 90-deg. angle was made by laying out three or four sections to make a neater and more gradual turn. Connections to the line were made by cutting an opening in the line with a cutting torch and fitting and welding the branch line in place. Dead ends or "bull plugs" were made by "orange peeling" the end of the pipe, heating the cut sections and hammering them into place, and welding them in the form of a hemisphere.

Within the last few years the industry has had one-piece forged or extruded fittings offered to it to replace these expensive and make-shift arrangements. One-piece forged ells in standard sizes, tees of various run and outlet combinations, and one-piece dished "bull plugs" of essentially the same physical and chemical characteristics as the pipe, are now available at installed costs comparable to the hand-made arrangements.

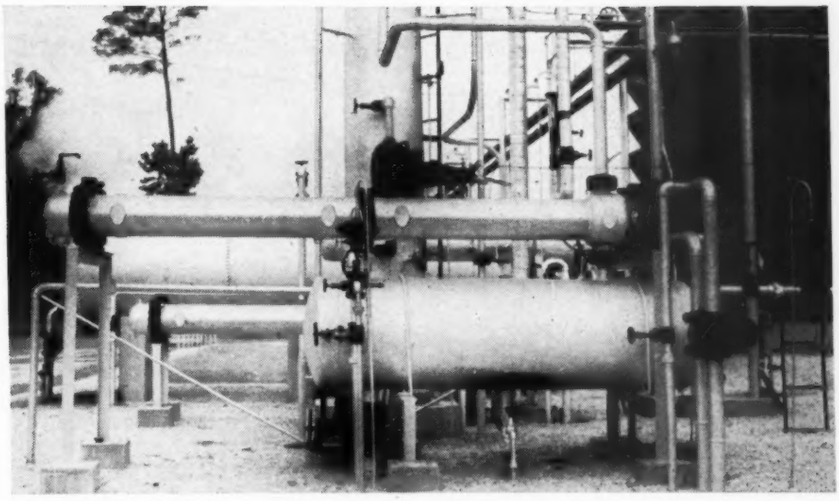
It is of interest here to note that tests have shown the friction loss of a forged elbow is 41.6 percent of that of a screwed elbow and only 19 percent of that through a mitered ell. The advantage of this factor alone may be readily visualized by noting the manifold shown in Fig. 6. Obviously the strength of forged fittings is greater.

Flanged joints or flange connections until recently were all of the cast-iron screw type. These were never entirely satisfactory because the vibration and high stresses in the line caused the threads to loosen or wear and leak and often the flanges themselves cracked, resulting in serious oil losses and considerable hazard.

Forged-steel flanges with extruded necks beveled for welding are now available in all sizes, weights, and drillings. They may be welded directly into the line, their cost is comparable to the screwed type, and they have none of its disadvantages, so their use is rapidly becoming universal.

(EDITOR'S NOTE: This article will be concluded in the next issue of *The Petroleum Engineer*.)

Heat exchangers and preheaters



By
J. C. ALBRIGHT

Natural Gasoline Plant Revamped to Process Gas From Deep Zone at Cotton Valley

United Gas Pipe Line Company's plant changed from compression to absorption type

FEW natural gasoline plants have been so situated that their useful life has been materially lengthened by the discovery of deeper oil and gas deposits after known supplies of casinghead gas have been exhausted. In the Cotton Valley field, Webster Parish, Louisiana, oil and gas were found in the Blossom sand in 1923, and the field was developed rapidly in 1924. Sufficient gas was produced to justify the erection of two gasoline plants, one of which is operated by the Ohio Oil Company, and the other by the United Gas Pipe Line Company. The latter plant was built on the outskirts of the village of Cotton Valley to extract gasoline from the gas produced from the Blossom sand but subsequently processed gas produced from the deeper Anhydrite section of the Glen Rose limestone, and from the Holloway sand.

The United Gas Pipe Line Company's plant was the type generally constructed for manufacture of natural gasoline and embodied ideas developed from actual experience in Northern Louisiana when efforts were being made to produce a product more stable than that manufactured in previous years by older compression methods. Equipment used in this plant included vacuum equipment and gas-engine-driven compressors of sufficient hp. to deliver the residue gas into commercial pipe lines for distribution as industrial and domestic fuel. The gas from the Blossom sand was moderately rich, but uncontrolled methods of development and production lowered reservoir pressure until the field was classified as a stripper area producing little oil or casinghead gas.

In 1937, Ohio Oil Company's No. 1 Bodcaw, in 28-21-10, discovered distillate and gas in the lower Marine zone, locally known as the Bodcaw sand, at a depth of 8189 ft., on an anticlinal fold, which has not yet been closed by drilling additional wells. Bottom-hole pressure is about 3200 lb.; distillate production is about one bbl. of fluid from each 15,000 cu. ft. of gas, and it is removed from the gas in conventional oil and gas separators in the field at each well or at a battery for a group of wells.

The deeper producing zone is classified as a gas area, production being based on volume instead of a per barrel basis. Production of distillate is secondary, but of major importance, nevertheless, as the allowable gas production permits production of several hundred bbl. of liquid per well. Chokes are used in series to lower the gas pressure for transmission lines, and refrigeration in the zones of greatest differential pressure lowers the temperature to freezing. This liquefies the "white oil" but not the natural gasoline fractions, unless carried to extremes. As the producers in the field are interested primarily in heavy distillate, the lower-boiling fractions are allowed to pass from the separators to the gas gathering lines leading to the gasoline plant.

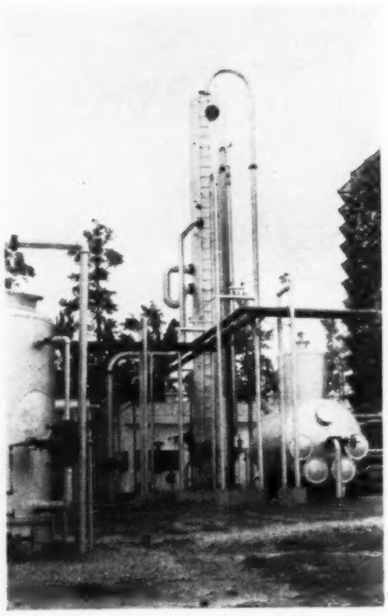
As soon as this deeper zone was proved to be productive of abundant oil and gas, the Cotton Valley plant was completely reconditioned, and most of the older equipment was discarded, including the gas-engine-driven compressors. Process coolers, still, heat exchangers, stabilizers, and auxiliary equipment, including instruments for controlling temperatures, pressures, and rates of flow are new. A 24-point indicating potentiometer is used to determine temperatures at given points quickly and accurately, and several recording instruments are installed at strategic points.

Pressures on the outlet of the field separators are so regulated that gas can be delivered to the plant at sufficient pressure to transport residue through commercial lines without recompression, which places the Cotton Valley plant in the type of well pressure operation. Only Bodcaw gas is processed since the plant was revamped, as all other gas is virtually depleted. For extraction of the available gasoline, about .475 gal. per M cu. ft., high-pressure absorbers are utilized. They require only six gal. of absorption oil per M cu. ft. of raw gas. After the gas has been gathered from the field separators it enters the plant through a field-type oil and gas separator installed as an intake scrubber. The gas temperature of 80 deg. fahr. is low enough that cooling by atmospheric sections is not required before the gas enters the absorbers.

Adequate protection is provided by

this scrubber, which is equipped with automatic liquid level control to dump the "white oil" when it enters the vessel, and as a further precaution, an electric alarm is used that functions when liquids accumulate in the separator faster than the equipment provided can dispose of it. A larger dump line, manually operated, is connected to the vessel so that the operator, upon hearing the alarm, can relieve the congestion. Oil so accumulated is directed to storage and shipped as such without processing through the plant, even though the color of the product is so-called "water white." If the volume of gas exceeds plant capacity, or if congestion occurs within the absorption unit, an adequate relief valve installed as a safety measure vents excess gas to the atmosphere until conditions can be remedied.

The absorber oil used in Cotton Valley has a stripped oil gravity of 39.3 deg. A. P. I. and is pumped from coolers to the absorbers at an average temperature of 86 deg. fahrenheit. The temperature and gas oil ratio are regulated to recover all desired fractions, but to exclude undesirable fractions, such as propane, by selective absorption. At an average plant load of 30,000,000 cu. ft. of gas per day, the amount of oil circulated is approximately 180,000 gallons. Even though plant control tests show only about .003 gal. per minute passing through the absorbers with residue gas, attempts have been made by increased oil circulation and reduced temperature to recover additional material, but they resulted only in overloading the stabilizer, which cut back the lighter ends and no greater production of marketable gasoline was obtained than at lower oil circulation and partial selective absorption. Consequently, the plant balance has been adjusted to recover maximum amounts of normal butane to produce 26/70 natural, the greater part of the propane passing through the absorbers with the residue gas.



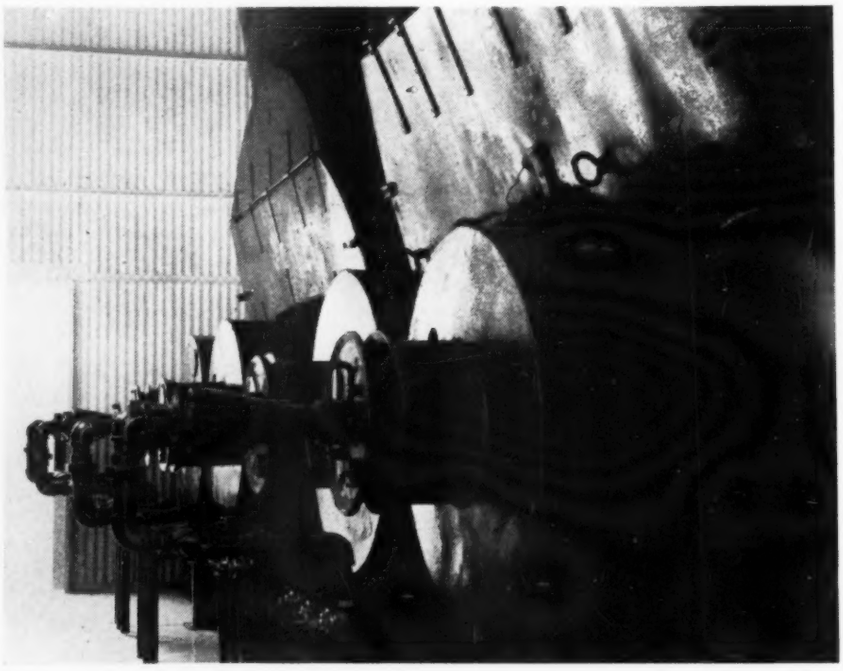
New still, which replaced older equipment in Cotton Valley plant

The rich oil is returned to the system at absorber pressure and has a gravity of about 43.7 deg. A. P. I., but its pressure is reduced to still pressure, which is about 39 lb. gauge under normal working conditions. The still is modern in every respect, designed for intermediate water removal and liquid reflux to control top temperature and end point of gasoline. The still is operated at a temperature of 325 deg. fahr. in the base, reduced to about 224 deg. fahr. at the top, sufficient to knock-back all heavy fractions contained in the oil, and to prevent carry-over of the oil itself.

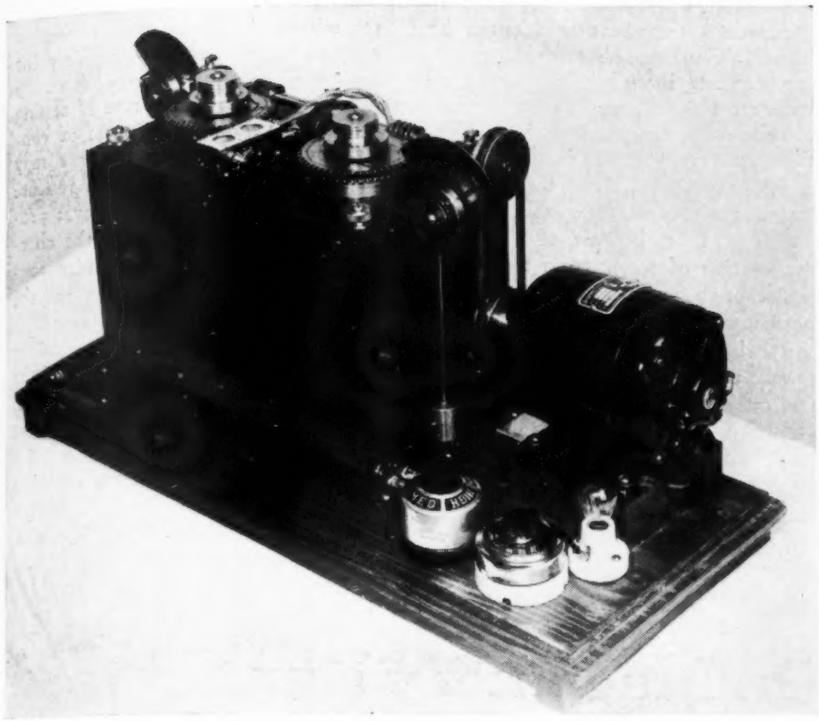
Still vapors are condensed in atmospheric sections contained in a louver tower. An accumulator temperature of about 84 deg. fahr. is maintained when the atmospheric temperature averages about 88 deg. fahrenheit. The condensate is pumped continuously to the stabilizer to remove all material not desired for 26/70 gasoline. The stabilizer is operated at a pressure of about 225 lb. gauge, which is controlled on the outlet of the reflux condenser by a balanced valve actuated by automatic instruments. The reboiler is heated by steam at a temperature of about 254 deg. fahr., the overhead being cut back with reflux to about 150 deg. fahr. when making the standard product. Stabilized material flows under process pressure through after-coolers to pressure storage from which it is loaded as required.

Loading is accomplished in a more or less conventional fashion, using vapor-tight dome covers and loading hose, taking loading vapors from the car through a recompressor engine for reprocessing. The rack is steel and is equipped with safety walks and rack-to-car bridges, which may be folded against the handrail when not in use, and fitted into a recess so as not to obstruct loaded cars.

The excess reflux from the stabilizer accumulator tank is allowed to vaporize by reducing the pressure to only a few pounds, and is used as fuel in boilers. Three Scotch Marine boilers and four oilfield type are required to supply sufficient steam for operating the plant. They are equipped with special butane burners to consume the stabilizer discard. Safety precautions are built into the fuel system, consisting of scrubbers and liquid level controllers that prevent anything but vaporized gas entering the boiler burners. Boiler feed is controlled by liquid level controllers, attached to each unit. Water for plant consumption is produced from deep wells in the yard, flowed with gas or air, and the quantity is controlled by level controllers on storage tanks so that no excess water is produced.



Stabilizer overhead gas is used as fuel in these Scotch marine boilers



A cement consistometer

Method that employs a consistometer is advanced as practical for field use in testing cement with particular reference to temperature and consistency.

By

JOHN E. WEILER*

Determining Suitability of Cement For Oil-Well Cementing

THE constant advance in the technique of oil well cementing is exemplified by the manufacture of cements especially adapted to the several general types of cementing jobs. Among the factors determining the suitability of a cement for a particular job, the following are deemed most important: (1) time required to attain a consistency beyond which the cement would be no longer pumpable under average conditions; (2) the consistency during the pumpable period as defined in (1) above; (3) the effect of temperature on the length of the pumpable period as defined in (1) above, and on the consistency as defined in (2) above; (4) the rate of attaining strength after being placed; (5) the ultimate strength of the cement, and (6) the effect of temperature on the rate of attaining strength and on the ultimate strength.

The methods and apparatus used in testing cement to be used at the surface are of little value in testing oil well cement. This is particularly true of the tests for determining the setting time and consistency, principally because there is no similarity between conditions of the tests and conditions imposed by oil-well cementing.

It is admittedly impossible to duplicate at the surface the conditions underground; in fact, it is probable that no two cementing operations are identical. However, some conditions are common to all types of cementing, and apparatus has been developed to simulate the conditions of oil well cementing.

A cement consistometer has been designed and is being used by a number of cement manufacturers and oil companies as a practical means of determining the suitability of a cement for oil well use insofar as temperature and consistency are concerned.

Two stirring chambers are provided, either of which may be disconnected and removed or replaced without disturbing the other. Both cylinders are immersed in a bath, which may be automatically maintained at any desired temperature. Inside the cylinders are paddles constructed of stainless steel and brass. These are held in a vertical position. The top of the paddle shaft is slotted to engage a pin through the knob, thus forming a coupling between the paddle and the knob. The knob is supported by a single-row ball bearing. A labyrinth arrangement just underneath the bearing forms a seal against the escape of water vapor when kept filled with oil, and assists in keeping the bearing clean.

The torque-indicating mechanism is simple and reliable. The inherent inaccuracies of springs as used in devices indicating graduated pull is avoided by the adoption of a simple pendulum construction. The pendulum is supported on a ball bearing. A string passed around the knob at the top of the rotating cylinder transmits to the pendulum the pull exerted by reason of the reaction of the plastic cement, rotating it from a plumb position to a height indicative of the consistency of the cement. A pointer fastened to the pendulum indicates continuously the consistency on a graduated quadrant. The quadrant scale behind the pointer is graduated in ten equal increments of torque, although the angular distance between successive graduations varies.

The outside container is constructed of heavy sheet iron, the corners welded to form a rigid one-piece construction capable of supporting the machined top assembly.

The bath is heated by two 500-watt

*Petroleum engineer, Halliburton Oil Well Cementing Co., Duncan, Oklahoma.

calrod units welded into the bottom of the outer container and so formed that the distribution of heat is uniform whether one or both heating units is in use. The two calrod units are connected to a three-heat switch in such a manner that by turning the switch to low, medium, or high the units are connected respectively in series, individually, or in parallel. These three rates of heating are available: 250 watts, 500 watts, and 1000 watts. In the low and medium positions the thermoregulator mounted on the top of the unit is included in the heating circuit. The required temperature is maintained by adjusting the thermoregulator by means of the knob on the side until the points barely touch when the thermometer is at the desired temperature.

Standard temperatures adopted by The Halliburton Laboratory for testing cements intended for use in oil wells are 100, 140, and 180 deg. fahr., as this covers the range of temperature most commonly found in oil wells. It is not practical to use the consistometer for temperatures much above 180 deg. fahr. because of the rapid evaporation of water from the slurry.

Although any of several water-cement ratios may be used, 40 percent water by weight of cement is commonly used in the general comparison and testing of cements. It is generally conceded that a cement having a long period of low consistency and a rapid rate of hardening is most suitable for most cementing operations.

Consistency readings are made at ten-minute intervals until a consistency of ten is reached. At this point the cement must be removed from the cylinder at once as the rate of setting is usually very rapid. Curves of consistency as a function of time may then be plotted for the temperature used. The shape of these curves provides an excellent index of the characteristics of the cement under consideration so far as consistency and the effect of temperature are concerned.

If the center of the slidable weight is set six inches from the center of the ball bearing supporting the pendulum, the readings indicated on the quadrant scale are approximately poises times 10. For purposes of exact calibration Bureau of Standards Standard Sample No. 7 may be used.

Why Do Belts On Machinery Run Toward The Large Diameter?

By W. F. SCHAPHORST

BY making a cone from an ordinary newspaper (Fig. 1), and cutting a straight strip of paper, which in this experiment will serve as a belt, it is easy to demonstrate why belts on oil machinery always run toward the large diameter.

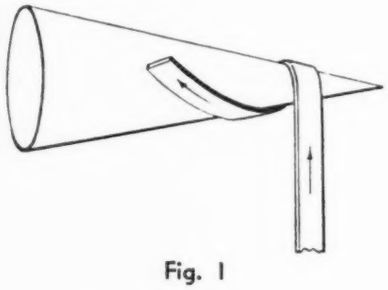


Fig. 1

Rotate the cone as though it were a pulley and as though it were pulling the belt onto itself. It will be found that the tendency of the belt is to wind around the cone in the direction indicated by the arrows. In other words the invariable natural tendency of the strip of paper is to wind rapidly toward the large end of the cone, which is the equivalent of a belt running toward the high side of the pulley. No matter whether this simple experiment is performed winding the strip frontward or backward, it will be found that the strip always winds toward the large end, or the "high side."

The performer of this experiment will also learn that the belt acts as it does because the belt is stiff and the curvature of the cone directs the stiff belt toward the large diameter. Even if the belt is purposely aimed toward the small diameter, it will not go there; it will move only toward the large diameter.

In an exaggerated way Fig. 2 shows the conical shape of one-half of an ordinary pulley. As the tendency of the belt is always to run toward the high side, or large end of a cone, it is plain that if two cones are placed base against base, as in Fig. 2, and a belt is run on either of the cones, the belt will move toward the greatest diameter, and after getting there it will stay there.

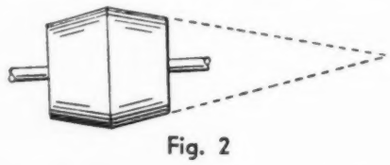


Fig. 2

By removing the peaks of the cones as indicated in the sketch, and reducing the exaggerated slope, a standard crowned pulley is formed. This therefore explains both why pulleys are crowned and why a belt always runs toward the large diameter. In fact (and this is an argument against the use of belts that are too wide and thin), there are records of wide, thin belts, running on pulleys of high crown, climbing up the cones with such force as to fold the belts in the middle upon themselves.

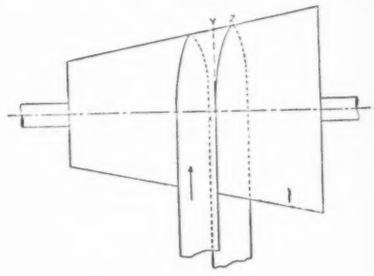
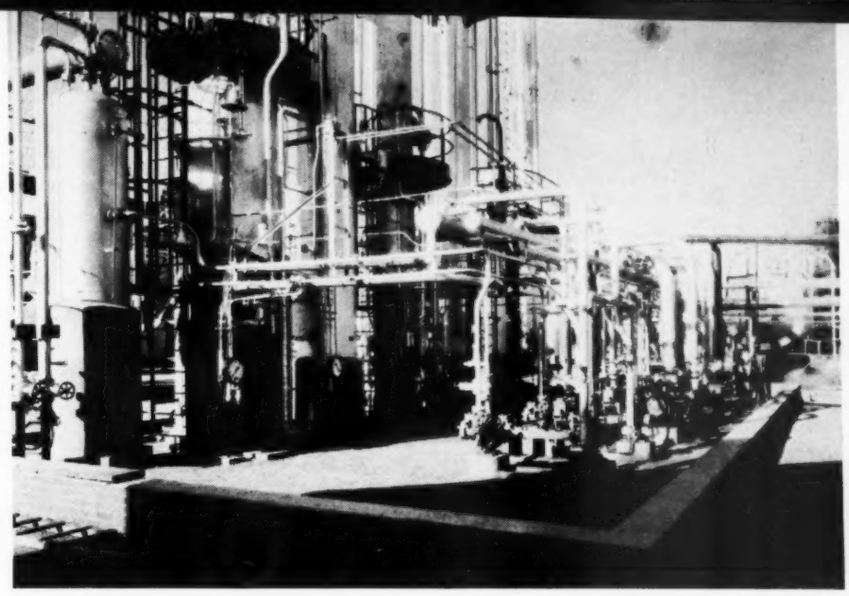


Fig. 3

An explanation that is somewhat more analytical is shown in Fig. 3. The belt first makes contact with the cone at X. If the pulley were truly cylindrical the point X would, of course, move to Y, but on account of the conical shape of the pulley and the stiffness of the belt it actually goes to Z and follows the dotted lines on the other side of the cone.



A view of the pressure polymerization plant in the Richmond refinery of the Standard Oil Company of California

(Photo Courtesy Standard Oil Company of California)

Development of new products and anticipation of new uses for those being manufactured among recent progressive steps.

Improvements in Refining Technique and Equipment Maintain High Quality of Products

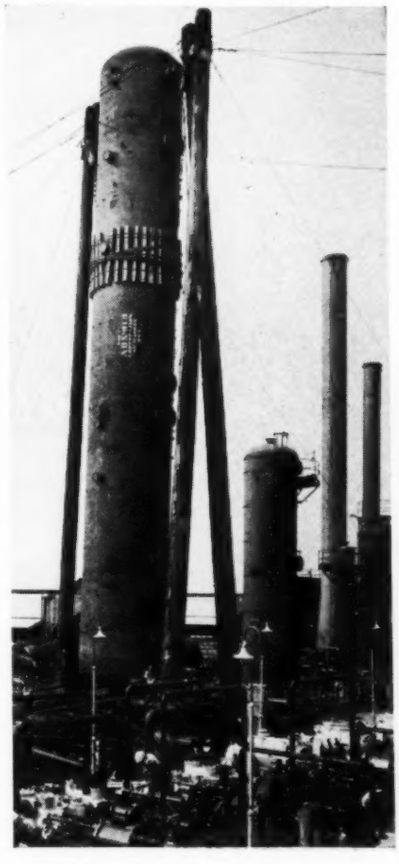
By WALLACE A. SAWDON, Petroleum Engineer, Los Angeles

THE improvements in refining technique and equipment during the last year have been made essentially to maintain the high quality of products, to anticipate new uses for products in an ever progressing industrial and automotive field, and to develop new products. Much of the construction work has been replacement of obsolete equipment but increased facilities and additional capacity have been provided at many plants. Equipment being installed will add another 100,000 bbl. of gasoline per day to the capacity now available in California.

There is still great interest in polymerization. This process not only conserves materials that might be wasted but also gives fuels certain specific valuable properties. In discussing catalytic polymerization[1] S. H. McAllister emphasizes the fact that the improvements in automobile and airplane engine design have necessitated the use of fuels of very high anti-knock rating and that polymerization of the lower olefins provides the principal source for such fuels. The total potential production of polymer gasoline is estimated at more than a billion gallons per year.

Referring only to the Martinez refinery of the Shell Oil Company, McAllister states that although the cold-acid two-stage process has been in use for some time and is still the most suitable method for preparing pure isooctane, the increased demand for polymer gasoline of 98- to 100-octane rating has led to the present development of the hot-acid process by means of which nearly twice the yield of octanes may be obtained from the same stock. The hot-acid polymerization process is, of course, a direct outgrowth of the former process.

It is also stated that in addition to the favorable effect on the olefin absorption, "hot-acid operation has a further advantage in that polymer as formed passes into the hydrocarbon phase, and is diluted by the inert butanes; its activity is thereby reduced, and there is less opportunity for re-arrangement of polymers of lower octane number. The result is that the polymer is 85 to 90 percent octanes as against 75 to 80 percent for the old or cold absorption process."



The big fractionating tower about to be set down on its foundation during construction of the Union cracking plant at Oleum

(Photo Courtesy Union Oil Company)

The polymerization plant having been placed in service and a new hydrogenation plant recently completed, the refining facilities of Standard Oil Company at Richmond are being further expanded by the erection of a new lubricating oil plant that will be finished before the end of the year. Further plans for additional facilities at this plant and at the Union Oil Company's Oleum refinery, the Associated Oil Company's Avon refinery, and the Shell Oil Company's Martinez refinery have been reported; and the San Francisco Bay refining area will be the scene of considerable expansion during the next year.

The largest refinery construction project in California at the present time is the Richfield Oil Corporation's plant at Watson. This work will involve an expenditure of $5,000,000 of which approximately 20 percent will be spent for six vertical heaters and their auxiliary equipment.

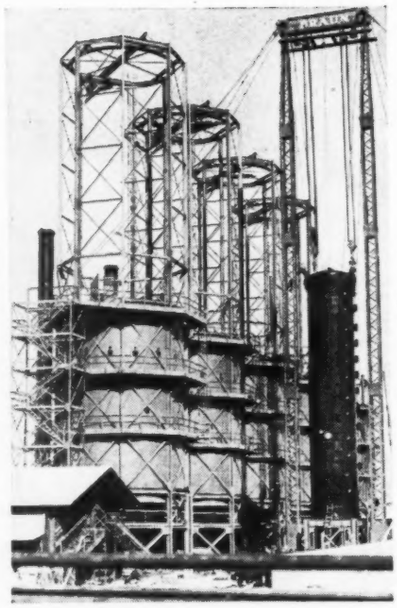
[1] "Catalytic Polymerization of Butylenes by Sulphuric Acid," by S. H. McAllister. Paper read at Annual Meeting, American Petroleum Institute, Chicago, Illinois, November 12, 1937.

Two combination topping and cracking units are being installed. Each of these will have a battery of four heaters consisting of three De Florez vertical down-fired tube type and one Alcorn double-fired horizontal tube type. The vertical furnaces are 30 ft. in diameter and 132 ft. high. Maximum uniform temperature obtainable is estimated at 1500 degrees.

Each combination topping and cracking unit has a capacity of 25,000 bbl. per day. The crude oil will first be pumped through a system of heat exchangers where it will take heat from the hot streams from the fractionating towers. It will then go to the horizontal heater, one side of which will be used to heat this oil and the other to heat reduced crude returning from the flash towers. Each side of the heater will consist of a radiant heating section surrounded by carbon-steel tubes; and gases from both sides will discharge into a common down-draft convection section where they will pass around the convection tubes. The crude entering the furnace will pass upward through a bank of convection tubes into the radiant tubes.

Heat transmission to the crude in this furnace will vary from 3.5 to 20 million B.t.u. per hour depending on the cleanliness of the heat exchangers. Fuel consumption will increase as the heat exchangers become dirty but the outlet temperature will be regulated automatically at 625 deg. fahrenheit. At this temperature the crude will pass to the flash towers where straight-run gasoline will be taken-off. Reduced crude returns from the flash towers to the horizontal furnace enter the constant-load side through a bank of convection tubes. In this side, 25 million B.t.u. per hour will be transmitted to the charge and the outlet temperature of the reduced crude will be 670 deg. fahrenheit.

In the three vertical heaters a uniform temperature of 1000 deg. fahr. will be maintained to induce cracking. The three large vertical furnaces in each cracking plant will permit practically any recycling ratio that may be desired.



The six vertical furnaces, which, together with two horizontal heaters, are an important part of the two new combination topping and cracking plants of Richfield Oil Corporation at Watson, California
(Photo Courtesy Richfield Oil Corp.)

There will be seven separating and fractionating towers for each combination topping and cracking unit. The largest of these will be approximately 13 ft. in diameter by 60 ft. in height and will weigh about 270,000 pounds. Provision is being made for refining all types of California crudes and some of the towers will be lined with an alloy to protect against corrosion.

In addition to the combination topping and cracking units, the construction will include a new polymerization plant. Contract has also been let for a re-run unit of the single-flash type having a capacity of 8000 bbl. per day.

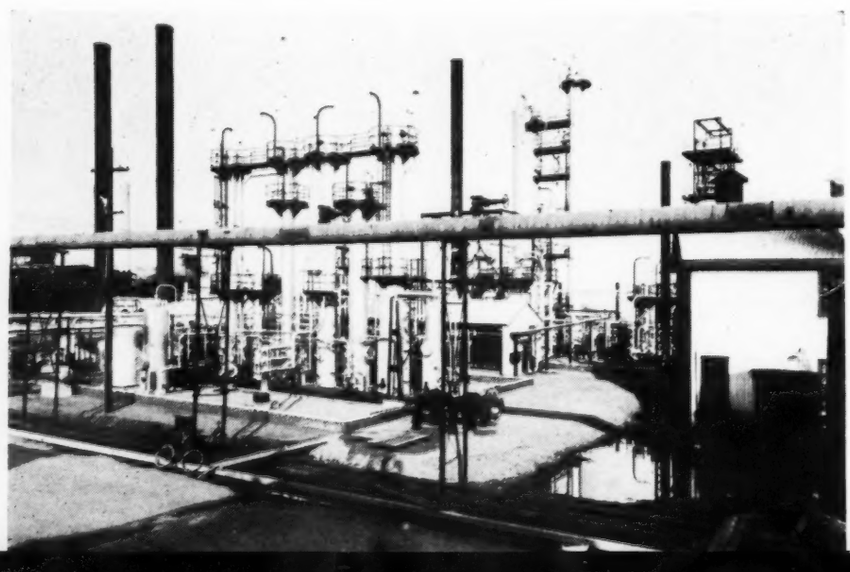
Union Oil Company's cracking unit at the Oleum refinery, on which construction was started about a year ago, has recently been completed. A new crude distillation unit to replace a 10,000-bbl. per day battery of shell stills was also built during the last year. This unit is designed to process 15,000 bbl. per day of either high-gravity Kettleman Hills crude or low-gravity Orcutt crude. It will combine an atmospheric fractionating column 9½ ft. in diameter with a vacuum fractionating column 11¼ ft. in diameter.

A fractionating tower for the cracking plant is asserted to be the largest piece of freight ever shipped west. This tower is 93 ft. long, 12 ft. 10 in. in diameter, weighs 151 tons, and is valued at $75,000. It consists of two steel units, a lining of high chrome steel welded to an outer shell of regular steel, and is designed to withstand the temperature and pressure necessary for the cracking process. Its transportation required three flat cars and it had to be shipped by rail from A. O. Smith Company at Milwaukee to Los Angeles instead of direct to the San Francisco Bay site because of the tunnels on the latter route, through which it could not pass. From Los Angeles it was sent to Long Beach for loading on a barge as no crane at the Los Angeles harbor could handle it. It was transported from there to Oleum by water.

At Union Oil Company's Wilmington refinery the enlargement and rearrangement of the asphalt plant has doubled the production and improved the quality of the product. A considerable amount of other new equipment has also been added to this refinery to increase output of various other products.

Wilshire Oil Company's catalytic polymerization unit was placed in operation about one year ago. A new reforming unit is now under construction. It will have a charging capacity of 4000 bbl. per day and will cost nearly $500,000. It is expected that the output of polymer gasoline will be increased considerably when the new reforming unit is in operation as more gas will be available for the polymerization plant.

Other plant additions made during the last year mainly for increased straight-run and cracking capacity include new installations at Torrance, Martinez, Avon, Bakersfield, Long Beach, Santa Maria, and at some of the smaller refineries in the Los Angeles Basin. Total crude throughput for the state is now 450,000 to 500,000 bbl. per day.



A general view of the polymer gasoline plant at Standard's Richmond refinery
(Photo Courtesy Standard Oil Company of California)

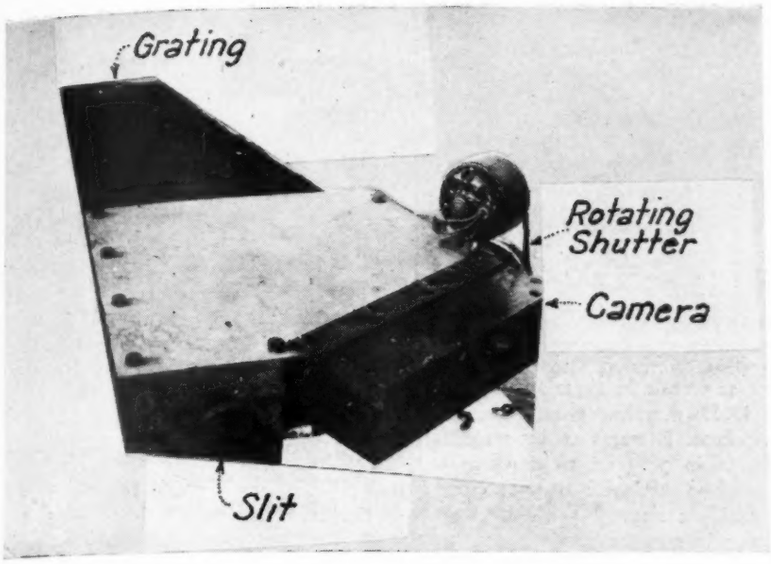


Fig. 1

By

ELDON A. MEANS[1]

Optical and X-ray spectrographs used to identify elements and minerals in formations and waters

Application of Some Spectroscopic Methods to Problems of Petroleum Geology and Engineering

THE application of spectroscopic and X-ray spectroscopic methods to the study of minerals has long been known. The application of these methods, especially of X-ray spectroscopy, to some problems in the oil field is new so far as the author is aware. This article is intended to be a discussion of the possibilities and a narration of some methods of spectroscopy used in solving petroleum geology and oil field problems.

The term "spectroscopy" is intended here to mean those processes using the diffraction properties of light or radiation as a means of chemical and mineralogical analysis. For the sake of clarity, perhaps a few words with respect to spectroscopy itself would not be out of place. Newton discovered that white light could be separated into its colors by passing through a prism of glass. Huygen later discovered that he could get the same effect by using a grating made by fastening very fine wires, parallel and very close to each other, on a frame. Today, by utilizing gratings made by ruling 15,000 to 25,000 lines per in. on glass, it is possible to measure very closely the wave length of light corresponding to any color. When an element is introduced into an electric arc, it emits light of characteristic colors, hence it is possible to use this process in analysis. The diffraction or separation that the light undergoes is controlled by the wave length of the light and the character of the grating. When X-rays are used, and the crystal planes are substituted for the grating, it is possible to gain knowledge of the structure of the crystals, the wave characteristics of the X-ray being known.

Fig. 2

The instrument for producing diffraction patterns from ordinary light is the optical or ordinary spectrograph. The parts are the slit, where the light enters the instrument; the grating, previously mentioned, and the camera, which records the diffraction of the beam.

Fig. 1 is a photograph of a spectrograph taken from above, showing the position of the parts. The light enters the slit, proceeds directly to the grating, and then spreads like a fan into its many colors or components. Fig. 2 shows what the spectrograph saw: each line belongs to a series of lines that uniquely and unerringly indicate that a certain element must have been present in the arc producing the light that entered the slit. The specimen to be analyzed is placed in a hole in the lower carbon electrode producing the arc. It is thus possible to introduce into the arc samples of limestone, sand, minerals, evaporated salts, and in fact anything, and the photographic film will unerringly indicate even the faintest trace of the elements present.

The instrument for producing X-ray patterns also consists of three parts. Corresponding to the slit in the optical spectrograph is the pin hole through which the X-ray enters. The sample under examination takes the place of the grating and spreads the X-ray to form lines upon the photographic film used to record the pattern. (Fig. 3). Needless to say the largest bulk of the X-ray unit is the transformer and the tube for producing X-rays. In the X-ray diffraction photograph (Fig. 4), the lines indicate the presence of certain crystal forms just as certainly as those of the optical

[1]The Eldon Means Laboratory, 418 West Douglas Street, Wichita, Kansas.

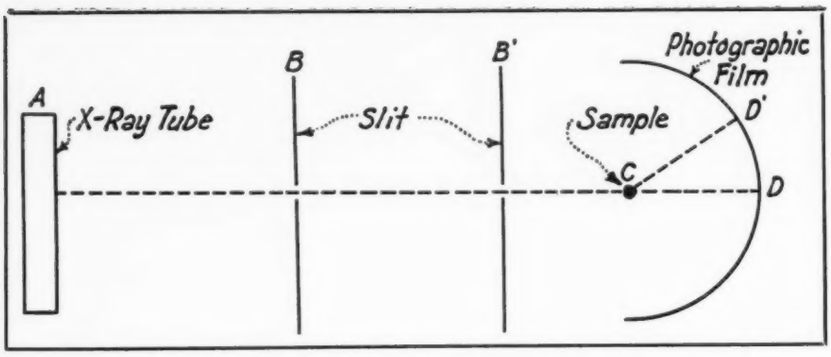


Fig. 3

instrument indicate elements. The optical spectrograph shows the elements that are present whereas the X-ray shows the combinations into which these same elements have formed themselves as crystals. It is thus possible to distinguish two forms of calcium carbonate having exactly the same composition but put together in a different pattern.

It has been found by Reynolds, Means, and Morgan[2] that six minerals would, in general, describe the constituents of an average drill sample. If these minerals are designated as A, B, C, D, E, and F, we can compile the following table:

TABLE 1

Formation	Pattern
Fort Riley lime	ECA
Florence Flint	ACE
Neva lime	BA
Americus	BAXC
Howard	BAD
Topeka	BAC
Mississippi	ACD or ABD
Viola Simpson	B, BC, or CB
Arbuckle	AC or CA

These are representative patterns chosen from several wells in Kansas. Most of these wells are in the central part of the state. The data thus accumulated were applied to a well in the western part of the state for the purpose of testing the value of the method. These data are shown in Table 2. We believe the correlation is good.

Perhaps a glance at some of the other possibilities would be of value. The minerals A to F, mentioned above, are identified as follows: A and B are quartz and calcite, respectively. C very definitely matches the calculated pattern for dolomite. D and E show fewer lines, and at this time their identity is not as certain as those already mentioned. D matches the pattern for strontianite. E seems to be aragonite. Work is in progress to confirm the constitution of these components. F is probably a clay.

Work is now in progress to apply the above method to the solids obtained upon evaporating oil-field waters. This will be reported later.

The crystal structure of drill samples offers possibilities for an insight into the history and origin of the strata. As an example, the difference between the two forms of calcium carbonate might be cited. The X-ray method easily distinguishes between these two forms. The importance of this distinction is discussed in Clark's "Data of Geochemistry." Inferences regarding the age of the strata, depth and temperature of precipitation, etc., may be drawn from a knowledge of the distribution of aragonite and calcite. Not to multiply examples needlessly, the occurrence of strontianite presents an interesting case. According to T. G. Thompson[3], calcium and strontium occur in marine shells in almost the same proportion as they do in sea waters. Theorizing on the solubility difference of these two elements,

[3]Thompson, Oceanography, National Research Council.

TABLE 2[2]

Changes in Type Pattern of Drill Samples for Successive Depths. Drill Hole in Sec. 25, T. 15 S., R. 24 W., Kansas

Sample	*Depth in Ft.*	*Formation*	*Pattern*	*Type*	*Formation Indicated*
161	2,590–2,600	Fort Riley	ECA	ECA or BCA	Fort Riley
162	2,650–2,660	Florence flint	ACE*	A, AC, AB	Florence flint
163	2,900–2,920	Cottonwood	CEABD	BAC	?
164	2,940–2,950	Neva	BECA*	BA†	Neva
165	3,060–3,070	Americus	BAEC	BAXC	Americus
166	3,260–3,270	Howard	BADX*	BAD†	Howard
167	3,410–3,420	Topeka	BACD* E*	BAC	Topeka
169	4,311–4,313	Mississippian	CAB	ACD	?
169 a	4,313–4,315	Mississippian	CAX*	or ABD	?
169 b	4,315–4,318	Mississippian	CABX*		?
169 c	4,318–4,320	Mississippian	ACDX*		Mississippian
170	4,418–4,422	Viola-Simpson	ABEX	B†, BC?, or	Mississippian
170 a	4,422–4,430	Viola-Simpson	ABEDX*	CB?	Mississippian
171	4,440–4,445	Viola-Simpson	BAC		?
171 a	4,445–4,450	or Arbuckle	BADC		?
172	4,499–4,502	or Arbuckle	BCX*		Viola
172 a	4,502–4,505	or Arbuckle	BC		Viola
172 b	4,505–4,510	or Arbuckle	CB		Viola
173	4,538–4,543	Arbuckle	CA*	AC or CA	Arbuckle
173 a	4,543–4,547	Arbuckle	CA*	AC or CA	Arbuckle
174	4,599–4,603	Arbuckle	ACX*	AC or CA	Arbuckle
174 a	4,603–4,608	Arbuckle	ACX*	AC or CA	Arbuckle
175	4,699–4,706	Arbuckle	CAD*	AC or CA	Arbuckle
175 a	4,706–4,708	Arbuckle	CAX*	AC or CA	Arbuckle
175 b	4,708–4,711	Arbuckle	CA	AC or CA	Arbuckle
176	4,719–4,726	Arbuckle	CA*	AC or CA	Arbuckle

*Indicates the mineral is present in rather small amounts.

†From outcrops.

[2]Application of X-Ray Crystal Analysis to a Problem of Petroleum Geology, by D. H. Reynolds, E. A. Means, and L. G. Morgan, Bull. Am. Assoc. Petrol. Geol., Vol. 21, No. 10 (October, 1937), pp. 1333-1339.

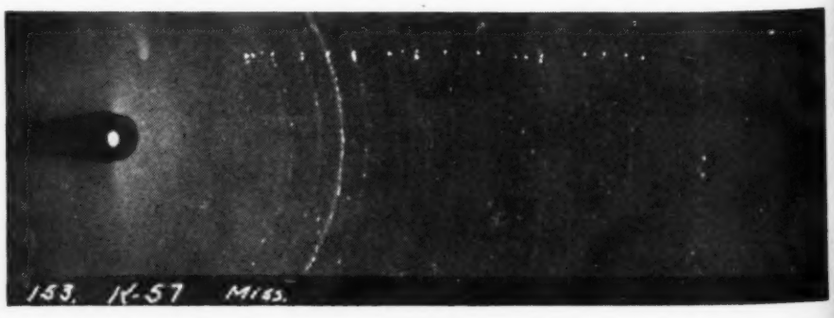
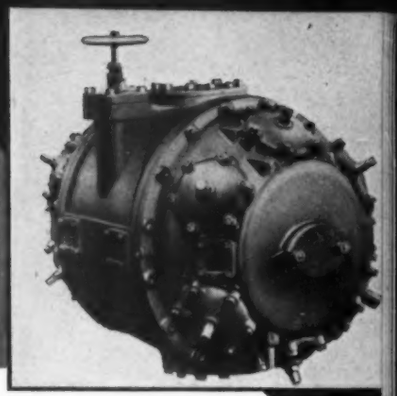
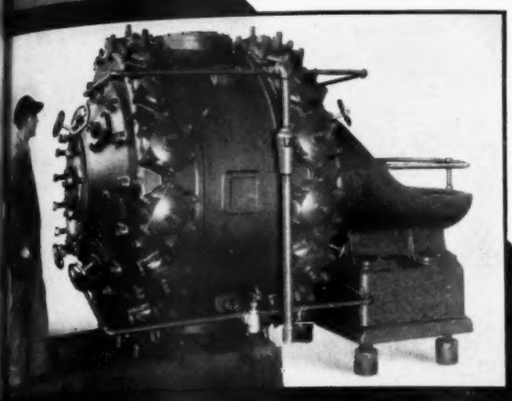


Fig. 4

SURE... There's a Difference in Compressor Cylinders!

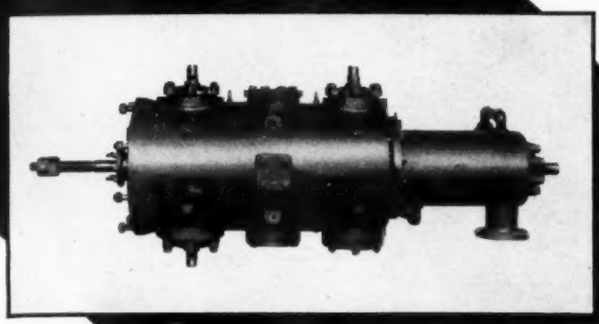


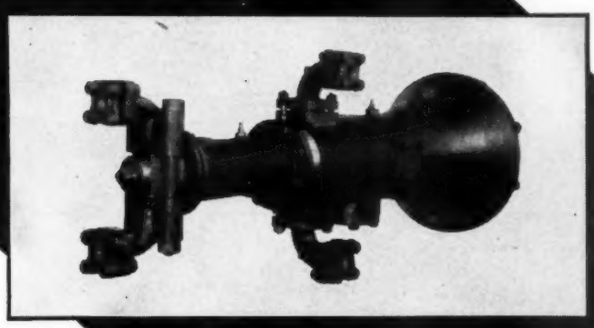


. . . and it's not just in size or shape. There's a vast difference in the strength and wearing qualities of materials that go into them. There's a difference in valve efficiency . . . and valve efficiency depends upon difference in design.

For low and medium pressures, Cooper-Bessemer compressor cylinders are made of Meehanite Metal . . . for high pressures, special analysis steel, either cast or forged. If you are interested in sizes and types, a few of the hundreds of Cooper-Bessemer-built cylinders are shown here . . . cylinders for pressures varying from a high vacuum to thousands of pounds.

Our engineers, modern foundries and machine shops are ready to serve you . . . Specify Cooper-Bessemer Compressor Cylinders and know the difference!





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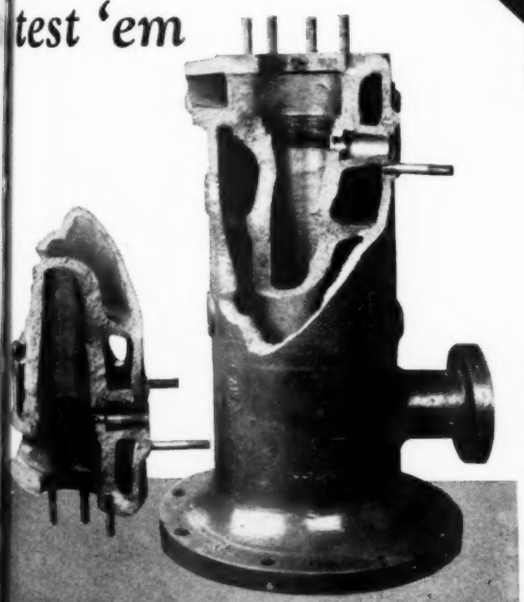
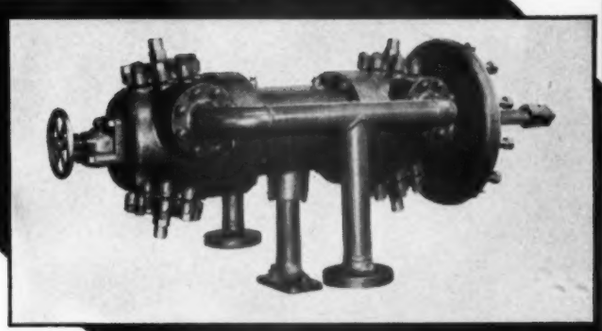


A cylinder of Meehanite Metal, designed for 1500 pounds working pressure. Subjected to hydrostatic pressure it ruptured at 10,000 pounds. Note the uniform metal structure of both thick and thin sections.



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it seems possible that in Arctic waters shells should be very high in strontianite, and in Tropical waters they should consist almost exclusively of calcite. Thus, we believe that the method has great possibilities, and will continue to gain in value as the number of samples surveyed increases.

Much work has been done by the use of microscopic and classical mineralogical methods upon the heavy minerals in sands. X-ray diffraction methods should be readily applicable in this field inasmuch as different mineral components may be readily recognized.

The use of optical spectroscopy for the purpose of studying the elements, which occur in matter in traces only, is well established, and the literature on the subject is voluminous. It would seem to have a place, however, in petroleum geology for the purpose of following "tracer elements", that is, elements peculiar to certain formations. The use of what is called a logarithmic sector makes the spectrograph reasonably quantative, and allows the calculation of elementary ratios such as potassium/sodium and strontium/calcium. Fig. 2 is a typical spectrogram of an oil-field water. Some of the elements are shown on the margin.

With one picture it is possible to make a quantitative analysis of most of the rarer elements that exist in either a drill sample or a water sample. Work is progressing on the compilation of this type of data on characteristic well brines in Kansas.

There are several advantages that result from the use of spectrographical methods in petroleum geology. The first is the certainty with which a mineral or an element can be identified. Second, one photograph each of the X-ray and the optical spectrograph are sufficient to identify and estimate any one of a great number of minerals and elements. Third, the size of the sample need be only a few milligrams. Fourth, the spectrograms, or patterns, form a permanent record and at any time that the need to identify any other elements or minerals occurs, the experimental work need not be repeated. Fifth, rare and unusual elements and minerals may be identified with the same ease as the more common ones. The disadvantages are the slightly longer time required to make an analysis of drill samples as compared to the microscope; the relative high cost of the equipment, and the time necessary to set up standards for quantative work.

The writer believes, however, that the use of spectroscopic methods should prove to be of help to the geologist, the petroleum engineer, and the oil operator, by supplying different and important knowledge about the strata through which and from which it is necessary to go to get oil.

Casting Sulphur Pipe*

By

ISAAC BENCOWITZ

Texas Gulf Sulphur Company, Inc.

SULPHUR, which because of its inertness towards water, certain electrolytes, and acids, has been used for years as a jointing and sealing compound in the construction of floors, sewers, acid tanks, etc., has also recently been used for fabrication of pipe and lining of steel pipes. The technique employed is similar to that used in the production of centrifugally-cast iron pipe. The apparatus consists of a rotating jacketed mold and a feeding mechanism. The mold is started cold and as it revolves at approximately 1000 r.p.m., a small quantity of molten sulphur is fed into it. This cools and sets and forms a skin on the mold. This skin is coated with fine coke and the combination facilitates the subsequent removal of the finished pipe.

After the preliminary skin of sulphur has been formed, a given quantity of coarse aggregate, followed immediately by a predetermined quantity of molten sulphur mixed with aggregate, is charged to the mold. The mold is rotated until the material is well compacted and until the formation of the pipe is complete. The mold is then stopped and heated with steam. The preliminary skin of sulphur cast in the mold melts and allows the easy withdrawal of the finished pipe.

The composition and characteristics of various sulphur pipes are given in the accompanying table.

Weight, lb./ft.	Composition, percent by weight					Strength, hydraulic pressure, lb./sq. in.	Tensile strength, lb./sq. in.	Specific gravity
	Sulphur	Sand	Coke	Gravel	Asbestos			
34	83	.....	.....	.....	17	95	152	1.77
35	66	16	7	.....	11	85	136	1.87
35	57	23	11	.....	9	65	104	1.87
38	35	.....	.....	60	5	75	120	2.23

The same principle may also be applied to the lining of steel pipe. A rather simple method of lining steel pipe consists in first coating the interior of the pipe with a bituminous material. A steam-heated core of the proper size is centered in the pipe and a mixture consisting of molten sulphur and aggregate is poured into the annular space. After the mixture has solidified, the core is removed, leaving a pipe having a homogeneous interior coating of sulphur.

Sulphur pipes are unaffected by changes in temperature and are resistant to many corrosive liquids. Pipes made of sulphur mixed with an aggregate have been exposed to extremely corrosive "bleed water," containing salt, sulphides, sulphates, etc., for more than two years without signs of deterioration. Sulphur-lined steel pipe has been used for the conveyance of brine and after three and one-half years of service is still in good condition.

Sulphur pipe can be made to withstand an internal pressure of 95 lb. per sq. in.; it has a crushing strength of 860 lb. per sq. inch. The chemical inertness of sulphur and its insulating properties may prove of value in transporting corrosive liquids.

*Abstract of a paper presented at the Dallas Meeting, April 20, 1938, of the American Chemical Society.

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Determining the Filtration Characteristics of Drilling Muds

Methods of ascertaining relationship of water-loss and cake thickness to time, temperature, pressure, composition of mud, solids content of mud, and type of filtering medium.

Part 1

By H. D. LARSEN*

IT has come to be realized generally by those engaged in petroleum production that the most important single characteristic of a drilling mud is its ability to form a thin and impervious cake on the walls of the hole. Other characteristics, such as a proper viscosity-weight relationship, suitable thixotropic properties, and freedom from gas-cutting, to mention but a few, are essential in varying degrees; but the presence or absence of correct filtration properties in a mud is so often the determining factor for successful mud performance in drilling operations that it takes precedence over all the others.

The process of wall-building by a drilling mud has been described qualitatively many times. The untoward and sometimes disastrous effects of employing a drilling mud of poor wall-building properties, that is, one lacking the ability to form a thin, impervious cake, has been stressed somewhat less; there may be mentioned as consequences inadequate walling-off of upper formations, to confine gas, oil, or water to their native sands; caving of loose formations possibly due to interfacial effects or due to the solution of cementing materials by entering water; caving of shale formations by swelling and disintegration upon absorbing water; sticking of drill pipe by decrease of hole diameter because of thick filter cake; difficulty in running casing as a result of caving or thick filter cake; difficulty in obtaining a water shut-off due to channeling of cement, and finally, impaired production of oil resulting from watered-off oil sands. A watered-off oil sand is one into which the water of the drilling fluid has penetrated. There has been, however a virtually complete lack of discussion of methods of analyzing data obtained by the various apparatuses devised to test wall-building properties, especially as regards correlation of water-loss and cake thickness with the many experimental variables such as time, temperature, pressure, composition of mud, solids content of mud, and type of filtering medium.

It is the purpose of this paper to present a method of recording filtration data whereby the effect of these variables may be ascribed to make experimental results from different sources intelligible, and more particularly to indicate several possible errors and somewhat erroneous procedures occasionally to be found in the different techniques.

The process of determining the wall-building properties of a mud consists essentially in filtering the mud through a medium of known area at a definite pressure and temperature for a given length of time, and measuring the water-loss as a function of time, and the cake thickness (or cake weight and composition) at the end of the run. The mud may be exposed statically or circulated past the filter face; pressures of 25 to 8000 lb. per sq. in. have been used and temperatures of 60 to 250 deg. fahrenheit. Filtering media have been compressed sand, natural cores, felt pads, filter paper, and porous alundum discs. The thickness of these filter beds has ranged from 0.1 mm of paper to 12 in. of sand.

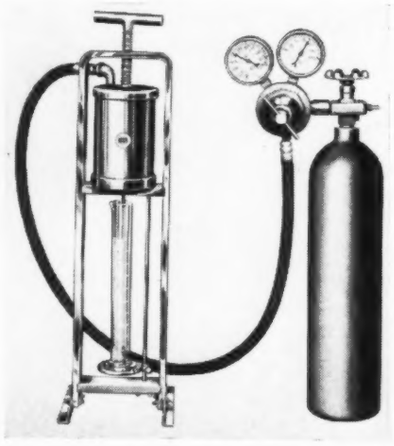

Fig. 1. Single unit, 100-lb. wall-building tester

The filter presses, so-called, have been of three general types. The closest approximation to actual well conditions is given by the high-temperature, high-pressure circulating filter press that has been in use at the Los Angeles laboratories of the Baroid Sales Department for more than two years. Only a brief description is given here. This apparatus, referred to hereafter as the "filter press," provides essentially a means for circulating muds over the top of a core, either a synthetic core made by compressing sand (as from disintegrated sandstone cores) at pressures to 12,000 lb. per sq. in., or a natural core. Any temperature less than 300 deg. fahr. and pressure less than 4000 lb. per sq. in. may be used. The thickness of the synthetic cores may be ¼ in. to 12 inches. Any type of natural core may be used (a core one in. in diameter and two in. long is cut from a larger core); and the porosity and permeability of any natural formation may be duplicated in the synthetic cores by a suitable choice of sand grain size and distribution. The diameter of the synthetic cores is 2.00 inches.

This filter press has been exceedingly valuable as a reference instrument owing to its wide range of variables. Nevertheless, it is complicated and time-consuming in operation, so that considerable effort has been directed toward developing a simpler apparatus. The first of these is the "Carver press," so-called because it comprises a laboratory-model hydraulic press of the type made by Fred S. Carver, and a specially designed filter cell. The cell consists of a base plate and cylinder attached thereto, and a piston fitting tightly in the cylinder. The whole is squeezed together between the platens of the press. At the bottom of the cylinder compressed sand, a felt pad, or filter paper is placed. The mud is poured on top of the filter disc, the filtrate escaping through a hole in the base plate. When filter paper is used a wire mesh is placed on top of the base to allow flow of filtrate below the paper. The Carver press differs from the filter press in the absence of circulation and the impracticability of performing runs

*Baroid Sales Department, National Pigments and Chemical Division of National Lead Company.

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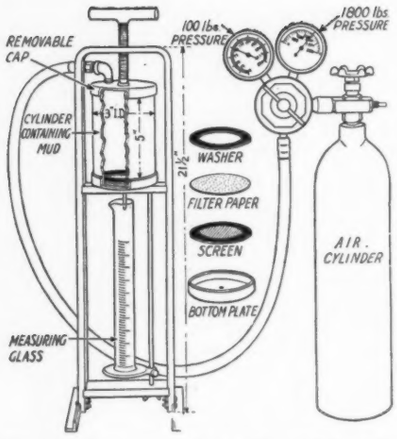


Fig. 2. Diagram of 100-lb. wall-building tester showing assembly

at high temperatures; however, somewhat higher pressures (8000 lb. per sq. in.) have been attained than with the filter press. Its chief practical advantages are the lower cost (less than one-thirtieth of that of the filter press) and the fact that one man can make eight or ten one-hour runs on two presses per day. The daily limit on the circulating filter press is about two one-hour runs or one three-hour run. The diameter of the cell in the Carver press is 2.25 inches.

Recently there has been developed a so-called pneumatic tester. (Fig 1.) This apparatus is portable, inexpensive, easy to operate, and well adapted to field as well as laboratory use. Mud is placed in a vertical cylinder, on the bottom of which are, in order, a filter paper, a wire mesh, and a base cup provided with filtrate outlet. (Fig 2.) Pressure is applied at the top by air, generally at 100 lb. per sq. inch.

The pneumatic presses are even more easily operated than the Carver presses, as it is not necessary to use a pump to maintain pressure, a high-pressure air cylinder with reducing valve or other source of compressed air being used. The chief disadvantage is the low pressure and temperature, which cause the water-loss and cake thickness to be deceptively low. The diameter of the cake formed by the pneumatic press is 3.05 inches.

To provide higher pressures and temperatures and yet maintain ease of operation in a filtration tester, there has been developed the high-pressure wall-building tester. The absence of upright posts allows water jacketing, and more compact design. The advantages to be gained from the use of both bottom-hole temperature and differential pressure will be apparent.

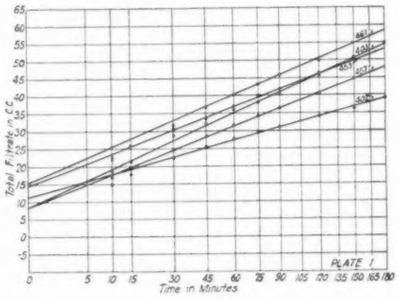
As mentioned, the two chief data obtained in filtration experiments are water-loss, i. e., volume of filtrate as a function of time, and the thickness of cake formed in a given time. Before treating in detail the effect on them of different experimental variables, such as temperature, pressure, solids content of mud, and filter bed material, it is necessary to describe a method of plotting water-loss data so that some quite incidental variables may be eliminated from the final water-loss to be considered.

Method of Plotting Water-Loss

The fundamental differential equation describing water-loss in a filtration experiment may be seen, upon consideration, to be as follows:

$$\frac{dQ_w}{dt} = \frac{k^2p}{\eta Q_s} = \frac{k^2pR}{\eta Q_w}$$

where Q_w and Q_s are respectively the *total* volumes of water and solids expressed and deposited during any time t, R is the ratio of Q_w and Q_s for the mud, as explained in detail elsewhere, k is a constant characteristic of the



mud (which may change if the colloidal state of the mud is changed by heat, chemical treatment, etc.), p is the differential pressure, and η is the viscosity of the filtrate at the temperature of the experiment. This equation has as its solution the following:

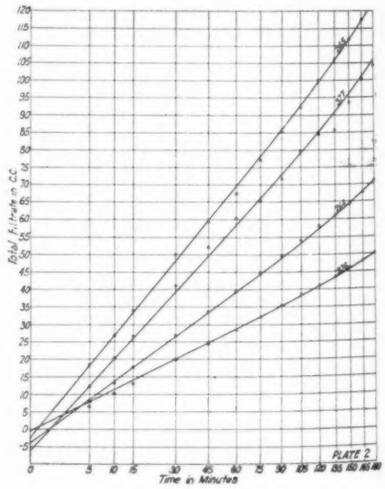
$$Q_w^2 = \frac{k^2pRt}{\eta}, \text{ or}$$

$$Q_w = \frac{kp^{0.5}R^{0.5}\sqrt{t}}{\eta^{0.5}}$$

This formulation assumes a non-compressible filter cake and the validity of Darcy's law. Although all clays so far tested have displayed compressible filter cakes, it will appear later that this may be easily compensated in the equation. Darcy's law appears to hold as regards the effect of filtrate viscosity and quantity of deposited cake, despite the non-homogeneity of the latter; at least all filtration experiments in which temperature and pressure are constant yield a virtually straight line when Q is plotted against the square root of time. The effect of filtrate viscosity will be considered subsequently.

The two equations above suggest that either Q^2 may be plotted against t, or that Q may be plotted against $\sqrt{t}$, and that in either case a straight line should result. It happens, however, that there is a constant error in Q resulting from an unaccounted-for loss or gain in filtrate at the start of the experiment. The volume of apparatus below the filter cake must be filled with filtrate before any can be delivered to the graduates in which the water is measured, giving a loss. Initial leakage through filter paper, etc., before a cake starts building gives a gain. A further cause is considered in the section on types of filter media. Now, if Q^2 be plotted against t, this initial error will distort the straight line into a curve, and the magnitude of the error must be deduced by a laborious and unsatisfactory trial-and-error method of determining what constant increment or decrement in Q results in a straight line (there are, of course, several other equally involved methods applicable.) On the other hand, *if Q be plotted against* $\sqrt{t}$, *a straight line will result regardless of any constant error in* Q, *and any such error is instantly found by the intercept of the straight line on the Q-axis.* It might be noted in passing that if there exists no such error in Q but there is uncertainty about the time of the start of the run, the first method of plotting will always give a straight line and the second a curve, unless t is in fact not in error.

A further alternative is to plot the logarithm of total filtrate against the logarithm of time, as for example, on log-log paper. This has some advantages; if the exponent of time in the equation given for total filtrate is not 0.500 but slightly more or less, as is sometimes true, a straight line will still result. Log-log paper shows no zero point for either time or filtrate volume, however, and the graduations are easily confusing to one not quite familiar



with its use. Moreover, curves for different muds will show nearly equal slopes (all virtually equal to 0.500, as may be seen from taking the logarithm of the equation for total filtrate) and hence are not readily adapted to cursory examination to reveal instantly a good or bad mud from the standpoint of water-loss, which after all is the reason for the filtration test. Further, no correction for initial water-loss is readily possible; we really measure experimentally a quantity described by the following equation:

$$V = kt^{0.5} + \varepsilon$$

where V is total *measured* filtrate and ε is the initial loss or gain. It is evident that this equation is linear in V and $\sqrt{t}$. If, however, we take logarithms, we have:

$$\log V = \log (kt^{0.5} + \varepsilon)$$

which is not linear in log V and log t. If ε is negligible, of course, we do have:

$$\log V = \log k + 0.5 \log t.$$

and in this special case a straight line results.

Bearing in mind, then, the disadvantages of each method, it is recommended that for general use the total filtrate be plotted against the square root of time and the best straight line drawn through the points. Besides allowing one to "average" all experimental observations by drawing a straight line through several points, a further advantage of graphing the results is that the line may be prolonged to meet any chosen time axis; that is, the results of a three-hour run may be predicted from a one- or two-hour run. The numerical factors to produce the same result are evident from the equation; for example:

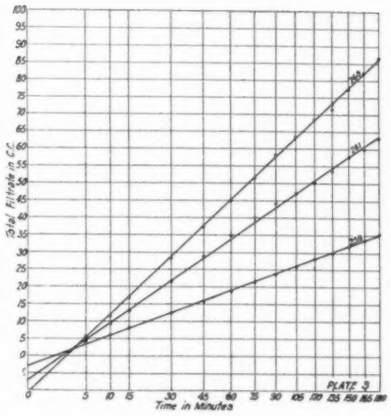
$$\text{(three hour filtrate)} = \sqrt{3}\ \text{(one hour filtrate)}$$

$$\text{(three hour filtrate)} = \sqrt{3/2}\ \text{(two hour filtrate)}$$

The slope of the curve is to be read from the chart, and is evidently the corrected water-loss for the time interval chosen, usually three hours. For example, in Plate 1, the corrected water-loss for the run marked "402" is 39.0 minus 11.3, or 27.7 cc. In Plate 2, for the run marked "377", we have 106.0 plus 6.1 or 112.1 cc. Justification for taking the slope of the line from the later readings, as in the first example, is given in another section. Sometimes the 5- and 10-minute readings are badly out of alignment, but the later readings nearly always present a straight line.

Effect of Temperature

It is seen from the integrated differential equation that the total filtrate at



any time, for any given mud cake, duly corrected for any initial loss or gain, varies inversely as the square root of the viscosity of the filtrate. *The viscosity or the plasticity of the mud itself plays no part,* except as these be symptoms of physico-chemical changes in the clay colloids themselves. The viscosity and square root of the viscosity of water at different temperatures are tabulated below:

°C.	°F.	η, centipoises	$\sqrt{\eta}$
0	32	1.792	1.339
10	50	1.308	1.144
20	68	1.005	1.002
30	86	0.801	0.895
40	104	0.656	0.810
60	140	0.469	0.685
80	176	0.3565	0.597
100	212	0.2838	0.523

Thus, other things remaining equal, a mud should lose

$$\sqrt{\frac{1.005}{0.2838}}$$

=1.88 times as much water at 100 as at 20 deg. centigrade. Conversely, the product of water-loss and square root of viscosity of water should remain constant for any given mud. It is found that this relation holds with surprising accuracy for most clays; there are some, however, that lose somewhat more at elevated temperatures than this simple relation would indicate; the explanation of such behavior is probably temperature flocculation and consequent loss in wall-building properties, although if the extraneous chemical content of the mud is appreciable, other effects such as break-down of deflocculating agent probably play a role. No clay has been found to lose less water at elevated temperatures than the quantity calculated from observations at lower temperatures. Composition of filter cake also plays a part, and is discussed under cake thickness.

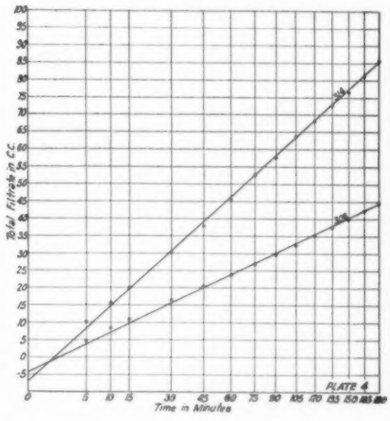
Plate 1 is a representation of the water-loss on the circulating filter press of a specially processed bentonite of uniform grade which will be referred to as "Aquagel." Data on these runs follow:

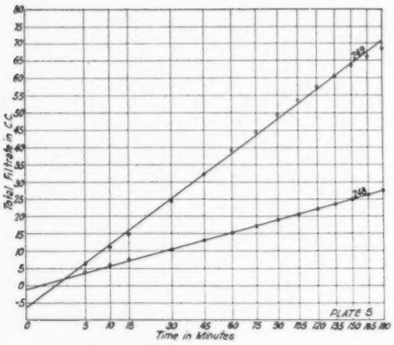
Run No.	% Solids	Temp., °F.	Press., lb./sq. in.	Viscosity, Centipoises at 70° F.	Water-loss in 3 hr.*	Loss · $\sqrt{\eta}$	Corrected for % Solids	Cake Thickness, in.
402	6.0	80	1000	....	27.7	25.6	25.6	2/32
453	6.5	150	1000	55	38.6	25.3	26.9	.....
457	6.0	150	1000	29	39.7	26.0	26.0	8/32
403	6.0	200	1000	26	46.3	25.5	25.5	4/32

*Water-loss from slope of straight line; see Plate 1.

The remarkable applicability of the theory may be seen by the consistency of the figures in the next to the last column. The fact that these figures are the same means, then, that *we may calculate, subject to the limitations hereinafter discussed, the water-loss at any given temperature from the experimental results at some other temperature.*

That viscosity is indeed a major factor in determining water-loss at any given temperature is nicely seen in the data plotted in Plate 2. In this series of tests the mud was made from a typical clay obtained from one of the deposits in the Mojave desert of California, which will hereafter be referred to as "Mojave desert" clay. Here a Mojave desert water-mud is compared with a Mojave desert sucrose-water-mud, both at two temperatures. The





sugar-containing mud was made of a 25 percent by weight aqueous sugar solution, and contained enough Mojave desert clay to have made a 79.5-lb./cu. ft. mud if water alone had been used. Data follow (filter press, 2-in. diam.):

Run No.	Density, lb./cu. ft.	Temp., °F.	Press., lb./sq. in.	Viscosity, Centipoises at 70 °F.	Water-loss in 3 hr.*	Loss · $\sqrt{\eta}$	Corrected for % Solids**	Cake Thickness, in.
264	81.5	86	1000	30	75.0	62.2	67.9	22/32
265	81.5	193	1000	36	125.2	70.6	77.1	36/32
376	(Sucrose)	86	1000	35	50.5	68.8	68.8	10/32
377	(Sucrose)	196	1000	35	112.1	87.2	87.2	16/32

*From slope of line; see Plate 2.
**Runs 264 and 265 converted to 79.5 lb./cu. ft. mud for comparison which runs 376 and 377. Method given under "Cake Thickness".

The viscosity of the aqueous phase of a Mojave desert mud was changed in runs 376 and 377 not by varying the temperature but by adding a substance that goes into true solution and thus increases the actual viscosity of the filtrate. The results permit the following deductions to be made: (1) Increase in temperature has a somewhat detrimental effect on the water-loss, the latter being some 10 percent higher at 190 deg. fahr. than a simple extrapolation from 90 deg. would indicate. (2) Loading the mixing water to a viscosity about twice that of water at the same temperature (actually 2.32 times at 86 deg. fahr. and 1.91 times at 196 deg. fahr.) by adding 25 percent sugar does not appreciably affect the wall-building properties of the clay itself at 86 deg. fahr.; the actual water-loss is reduced to about ⅔ its normal value as would be quantitatively predicted from the increased viscosity of the aqueous phase. (3) At 196 deg. fahr. the sucrose Mojave desert mud is adversely affected by the high temperature, and loses about 20 percent more water than would be calculated from the viscosities involved. (4) Doubling the viscosity of the aqueous phase by using sugar has little effect upon the Stormer viscosity of the mud (see the fifth column in the table).

There are several native clays that exhibit anomalous behavior at elevated temperatures. Filter press results for a West Texas clay, commonly used in the Gulf Coast, and hereafter designated as "West Texas" clay, are given in Plate 3 for three temperatures, 80, 150, and 200 deg. fahrenheit. Data for the muds follow:

Run No.	Density, lb./cu. ft.	Temp., °F.	Press., lb./sq. in.	Viscosity, centipoises at 70 °F.	Water-loss in 3 hr.*	Loss · $\sqrt{\eta}$	Cake Thickness, in.
259	76.5	80	1000	37.5	38.0	35.2	13/32
261	76.5	150	1000	37.5	70.6	46.4	18/32
260	76.5	200	1000	37.0	96.3	53.3	26/32

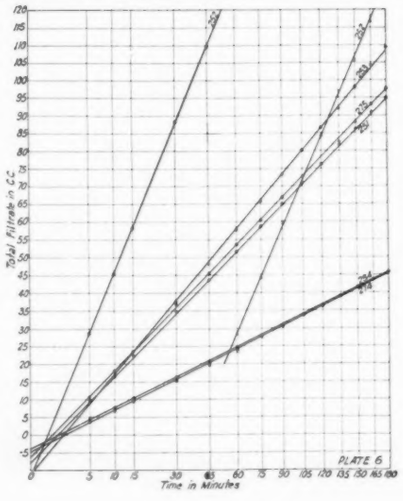
*From slope of lines on Plate 3.

It may be seen that as the temperature is increased, the wall-building properties of the mud grow progressively worse; that is, worse than would be predicted from results at lower temperatures. Thus *caution must be used when testing drilling muds at room temperature when one is actually interested in performance at elevated bottom-hole temperatures.* For example, the mud of Plate 3 when tested at 80 deg. fahr. loses only 37.2 percent more water than the Aquagel mud of Plate 1; but at 200 deg. fahr. it loses 107 percent more water than the Aquagel mud at 200 deg. fahrenheit.

Aquagel when added to muds made of native clays invariably improves wall-building properties over the native clay used alone in a mud of virtually equal viscosity. The usual procedure is to dilute the mud to 72 to 76 lb. per cu. ft. depending on the clay, and add 3 to 2 percent Aquagel. As long as a considerable amount of native clay remains in the mud, however, the good or bad wall-building properties of the clay will persist to an extent roughly dependent upon the quantity present. For example, we have seen in Plate 2 that Mojave desert clay is not badly affected by temperature. Thus, the temperature-corrected water losses at 83 deg. and 193 deg. were respectively 67.9 and 77.1 cc. If this mud is diluted to 72 lb. per cu. ft. and 3 percent Aquagel added, the result is as given in Plate 4; and data therefor is shown in the table immediately below.

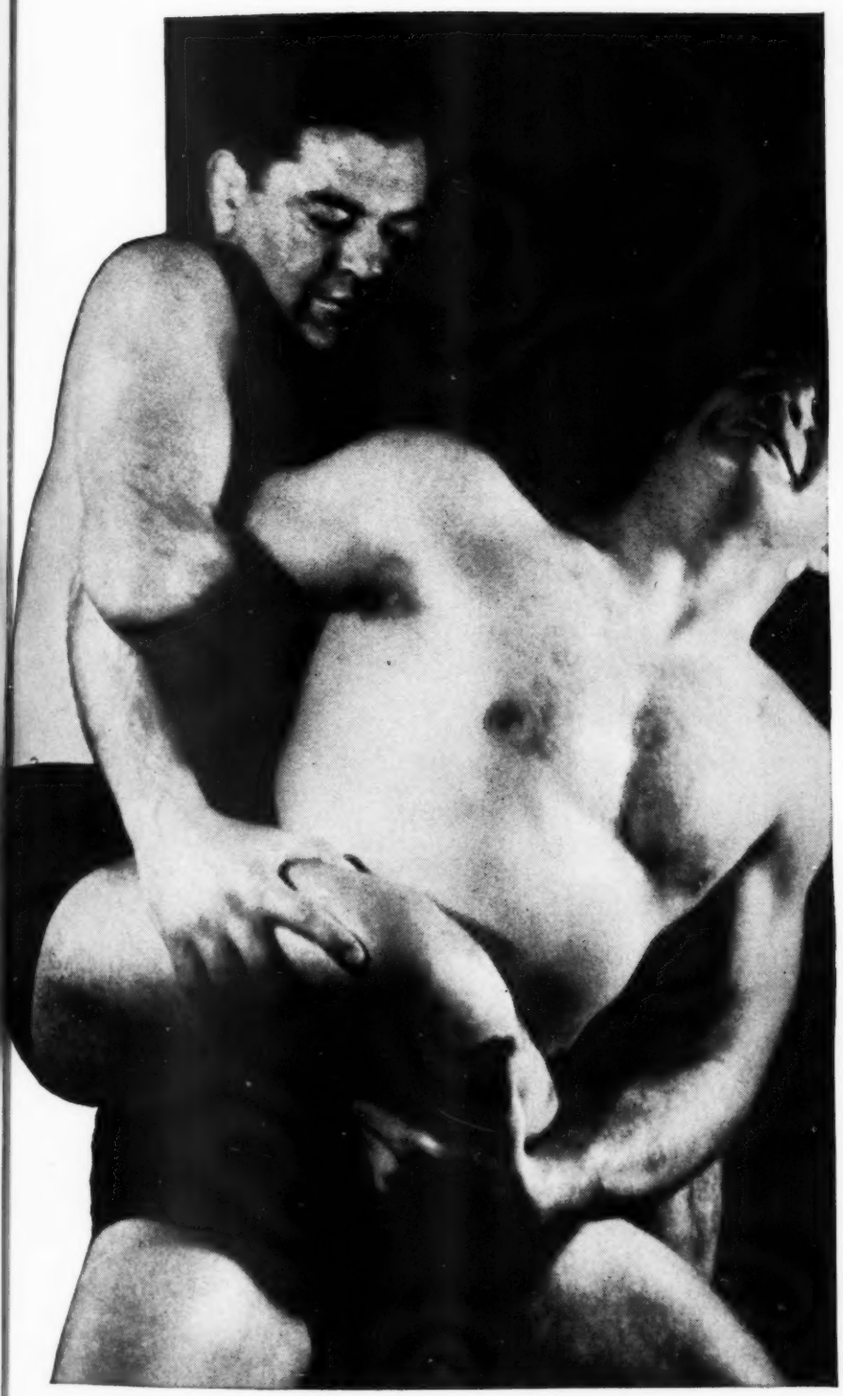
Thus the Aquagel-containing mud lost about 32 percent less water than the straight native clay at 80 deg. fahr., and about 32½ percent less at 200 deg. fahrenheit. If the Aquagel mud had been built to the viscosity of the comparison mud, 30 to 36 centipoises, instead of merely to 12.8 centipoises, by adding somewhat more Aquagel, the reduction would have been of course even greater. Even so, the cake thickness was more than halved.

Run No.	Density lb./cu. ft.	Temp., °F.	Press., lb./sq. in.	Viscosity, centipoises at 70°	Water-loss in 3 hr.	Loss · $\sqrt{\eta}$	Cake Thickness, in.
308	73	80	1000	12.8	48.8	45.3	9/32
314	73	200	1000	12.8	92.4	50.8	17/32



This retention of native mud characteristics is further illustrated by the mud of Plate 3, diluted, however, to 72 lb. per cu. ft. and 3 percent Aquagel added, together with 1:500 by volume of Stabilite No. 4, which is an

THE BIG 'SQUEEZE'



"GAS on top of the oil!" Yes, and how to keep it there where it will do the most good—a Squeeze Job right in the gas-cap. Can you do it? Yes, if you use 'Starcor'!

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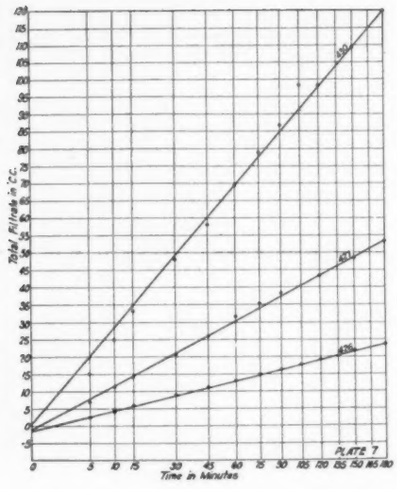


effective and commonly used mud thinner. Results for this mud are shown in Plate 5, and data therefor follow:

Run No.	Density, lb./cu. ft.	Temp., °F.	Press., lb./sq. in.	Viscosity, centipoises at 70 °F.	Water-loss in 3 hr.	Loss · $\sqrt{\eta}$	Cake Thickness, in.
248	72½	80	1000	35	28.2	26.2	10/32
249	72½	200	1000	40	77.1	42.4	22/32

It will be recalled that the original native mud had temperature-corrected losses of 35.2 cc. and 53.3 cc. at 80 deg. and 200 deg., thus exhibiting a very bad change of water-loss with temperature. Although the mud developed an excellent water-loss at 80 deg. fahr. by dilution and addition of Aquagel, the poor temperature response of the native mud prevailed.

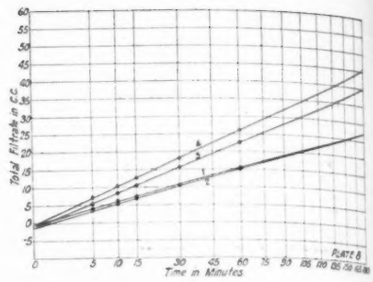
Chemical treatment very often produces a better high-temperature behavior. As an instance, data are given on some muds plotted on Plate 6:

Composition of Mud	Run No.	Temp., °F.	Press., lb./sq. in.	Viscosity, centipoises at 70 °F.	Water-loss in 3 hr.	Loss · $\sqrt{\eta}$	Cake Thickness, in.
81 lb./cu. ft. Antelope*	251	80	1000	27	102.5	95.4	32/32
	252	200	1000	28	239.9	132.0	42/32
72 lb./cu. ft. Antelope plus 5.5% Aquagel	254	80	1000	21.5	49.6	46.1	10/32
	253	200	1000	21.5	119.5	65.8	20/32
Same plus 1:500 Stabilite No. 4	274	80	1000	17	50.8	47.2	12/32
	275	200	1000	14.5	103.5	56.9	20/32

*The mud designated as "Antelope" was procured from the Antelope Valley, which lies on the west side of the San Joaquin Valley of California, a region where ground waters are highly mineralized.

Dilution with water and addition of Aquagel more than halves water loss and cake thickness of the original mud. The percentage increase in loss with temperature remains about the same, however. When Stabilite is added, the viscosity is reduced; the low temperature water-loss remains about the same, but the high temperature loss is reduced about 13 percent. Even so, it is to be noted that although this mud contains 5.5 percent Aquagel, the water-loss is still much higher than that of a straight 5.5 percent Aquagel-water mud. Too much of the poor native clay remains.

A good clay may be used with Aquagel and good results obtained, as noted above. In addition, and greatly in contrast to the behavior with poor native muds, Aquagel may be used with a perfectly neutral substance, provided this substance does not act as a filter-aid. Baroid is finely ground and specially processed barytes, to which is added a maximum of 5 percent Aquagel for suspension and wall-building properties. Each particle is a very small yet perfectly defined, compact crystal, and when used with the proper amount of Aquagel does not affect the wall-building properties of a given mud—native or straight Aquagel—one way or the other. Substances are sometimes used in drilling muds, however, that have the physical characteristics of filter-aids. It will be recalled that silica in the form of diatomaceous earth, finely divided asbestos, precipitated calcium carbonate, bone charcoal, wood flour, and the like have the property, because of their finely porous and foraminate character, colloquially, though incorrectly, known as "amorphous," of multiplying the filtration rate of difficultly filtrable suspensions many times, and hence are widely used in the industrial clarification of such sludge-bearing substances as sugar liquor, lubricating oils, and the like. When these materials are added to drilling muds, it is natural that they greatly increase the water-loss and correspondingly the cake thickness. Consider the behavior of Baroid, of amorphous silica, and of iron oxide as shown in Plates 7 and 8. In Plate 7, 6 percent Aquagel muds were weighted to 97 lb. per cu. ft. with Baroid and with iron oxide, and the muds tested in the filter press. Data to accompany Plate 7 follow:



Mud	Run No.	Temp., °F.	Press., lb./sq. in.	Viscosity, centipoises at 70 °F.	Water-loss in 3 hr.	Loss · $\sqrt{\eta}$	Cake Thickness, in.
Baroid	426	80	1000	74	25.2	23.4	7/32
Baroid	427	200	1000	74	54.8	30.1	11/32
Iron Oxide	430	200	1000	81	119.2	65.6	26/32

It will be seen that the Baroid mud at 200 deg. fahr. has a temperature-corrected loss of only 30.1 cc., compared to about 26, for straight bentonite, whereas the iron oxide mud loses more than twice as much water and the cake is more than twice as thick.

The point is further illustrated by Plate 8, which presents data at 20 deg. cent., 100 lb. per sq. in. pressure, pneumatic press, for four muds as follows:

1. 4% Aquagel.
2. 4% Aquagel weighted to 86½ lb. per cu. ft. with Baroid.
3. 4% Aquagel weighted to 86½ lb. per cu. ft. with amorphous silica.
4. 4% Aquagel weighted to 86½ lb. per cu. ft. with iron oxide.

The great increase in water-loss and correspondingly in cake thickness upon adding filter aids may be seen, even though this addition amounts to only ten percent of the volume of Aquagel mud in the case of, for instance, the iron oxide.

(EDITOR'S NOTE: This article will be concluded in the next issue of *The Petroleum Engineer*.)

Principal Factors of Absorber Design

Depth of liquid on plates and velocity of vapor determine time of contact and efficiency of absorption

By R. H. TURNER

THE absorber is one of the most important parts of any gasoline absorption plant and its selection should be given the most careful consideration, as the operation of the entire plant depends largely upon its successful operation. The function of the absorber is to mix intimately the gas and the mineral seal oil, so that the latter is able to absorb all desired gasoline fractions in the gas.

Filled Type Columns: One of the first types of absorbers to be used after the introduction of the charcoal plant was the filled type, which was nothing more than a vertical cylindrical shell packed with any one of numerous different types of materials to break the descending mineral seal oil into thin streams and to bring the ascending currents of gas into intimate contact with these streams. Steel shavings were used extensively, as were stones and gravel. The most serious handicap was the lack of distribution of the oil and the gas because of the settling of the filling of the towers and the resultant channeling of both fluids.

Wood-Grid Absorbers: The filled-type absorbers were somewhat improved by reduction in diameter and increase in height. The area open to fluid flow was increased by the substitution of wooden grids, or lattice work, for the filling. Some of these grids were made of redwood, some of cypress, and some of common pine. They were found to have a short life; they would break from one cause or another and end up usually in the fat-oil-pump suctions, partly stopping these lines and increasing pressure drops at the worst place.

Spiral-Tile Absorbers: Another type of filling for the older types of fractionating columns was the Raschig Ring, which was named for its inventor. These rings were not arranged in the tower, but were dumped in, forming a fairly uniform packing, because their length equalled their diameter, and because of this fact they tended to minimize channeling of the oil and gas. Another similar type of packing that was used extensively for a while was the vitrified tile packing. These tile were three to four inches in diameter and length, and passing through them longtitudinally were several peripheral passages to give a whirling motion to the gas and oil.

Plate-Type Columns: Columns of the plate design soon replaced the spiral-type columns. Fractionating columns usually contain a number of superimposed sections separated by plates, the plates being so constructed that the vapor passing through them comes into intimate contact with the liquid on the plates. The liquid on a plate is discharged onto the plate below by means of suitable downpipes while the vapor passes upward through the plate, through the liquid, to the next higher plate in the column, and so on. The plates in fractionating columns differ mainly in the design of the devices by which the vapor and liquid are brought into intimate contact.

Perforated-Plate Column: The simplest type of plate construction is the perforated type wherein there are a large number of holes drilled in the plate. The vapor passes upward through these holes and prevents the oil from passing downward through them. The oil is taken from each plate to the one below by suitable downpipes that are vapor sealed. This type of plate is efficient if the holes are very small and very close together. The gas velocity must be sufficiently high that the pressure at each tray exceeds the static head on the tray, in order to prevent the liquid from passing downward through the vapor holes. If the velocity is too great, however, the vapor tends to lift the liquid from the plate and destroy the intimate contact between vapor and liquid that is essential to maximum efficiency of the plate. Another difficulty, particularly in columns of large diameter, is that if the plate is not horizontal the liquid will collect at the lower part of the plate and the vapor will tend to pass in larger volumes through the holes in the higher part of the plate, resulting in poor contact.

This type of plate is also disadvantageous when fluids being treated contain foreign matter that will tend to be deposited in the vapor holes, as such deposition renders a part of the plate useless.

Liquid Seal on Plate: The next improvement in the plate-type column was the forming of a permanent liquid seal on each plate. This was accomplished by placing a liquid-tight ring around the holes through the plate, thereby preventing the level of the liquid from falling below the upper edge of these rings. Covers were then placed over these rings to force the rising vapors to pass through this liquid seal before passing upward to the next tray.

This type of plate was found to be much more efficient because of the more intimate contact obtained by bubbling the vapor through the oil. It is from this action that the bubble tower derives its name.

Slotted Bubble Caps: The efficiency of the bubble plate was further increased by cutting in the circumference of the bubble caps numerous slots in the shape of a parallelogram (Fig. 1). The cross-section of the slots at "A-A" is made smaller than at B, so that the farther away from "A-A", the lower the velocity and hence the less pressure required to force the gas or vapor through the slot, which tends to permit the passage of the fluid through the entire cross-sectional area of the slot. It is common knowledge that the more deformed in shape the bubble passing through the liquid, the greater the exposed outer surface in contact with the oil, and the greater the efficiency. A number of different type slots, as well as round and square holes, have been employed in different types of designs and very little difference in efficiency has been recorded, as all attain practically the same end; namely, the forming of a large contact surface between the liquid and the vapor.

An attempt has been made to increase the efficiency of the bubble cap by the use of teats extending horizontally for approximately one-half inch directly above each slot. It was thought that this method would provide a means of further deforming the bubbles after they had passed through the cap slots, in order to expose to the oil a surface other than that already in equilibrium with the oil from the first contact. This idea was found to be correct in theory only, and was not found to increase plate efficiency appreciably.

(Continued on Page 54)

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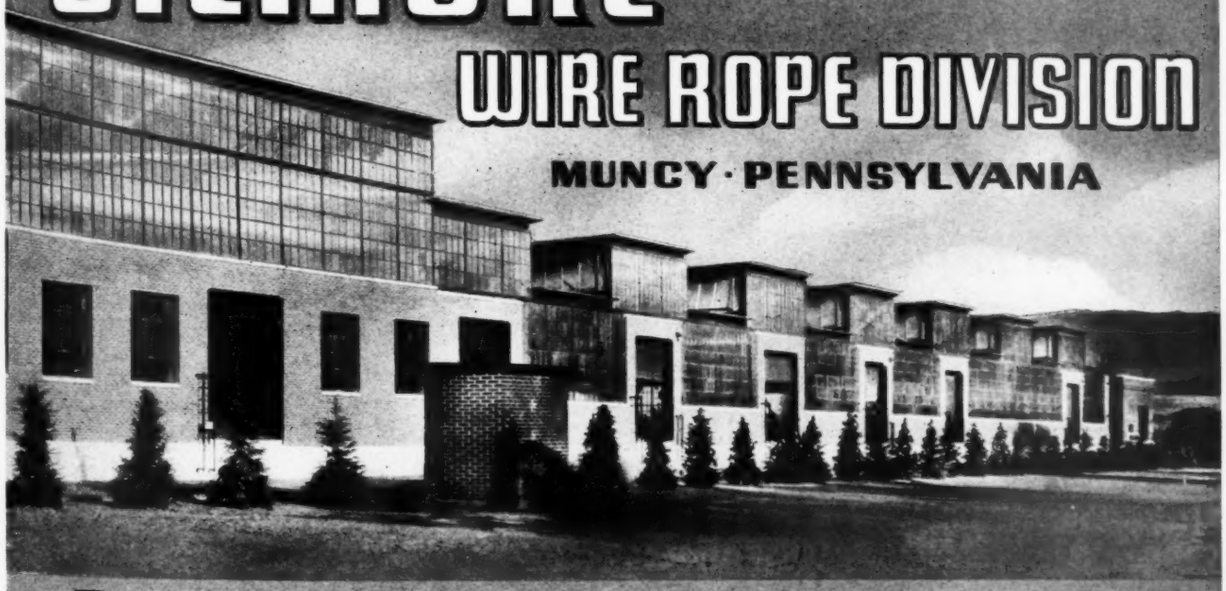

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(Continued from Page 51)

Efficiency of Columns: Experiments performed in a number of laboratories and innumerable field tests have shown conclusively that the efficiency of fractionating columns is not only a function of intimacy of contact between the vapor and the oil but also is dependent upon other factors, notably the velocity of the vapor through the column. Other conditions being constant, equilibrium between the vapor and the liquid will be more closely approached as the time of contact is extended. In the plate-type column this increased time of contact is obtained by increasing the depth of the liquid on the plates. It has been shown, however, that when a bubble emerges from an opening into a liquid, the vapor near the surface of the bubble reaches equilibrium with the liquid almost instantaneously, and the vapor in the interior of the bubble, not being in contact with the liquid, does not come into equilibrium with the liquid, except by diffusion of the vapor from the surface of the bubble. When a bubble is introduced into a liquid it immediately assumes a spherical shape and, if allowed to rise through the liquid untouched, practically no further reaction will occur. As the rate of diffusion of the vapor in the bubble is very slow in comparison with the time of contact of the vapor and the liquid, an excessive depth of liquid is of no material aid in increasing plate efficiency, provided the bubbles are allowed to rise through the liquid undisturbed. It can readily be seen, however, that if at any point or points in its passage, it is deformed or broken in any way a fresh portion of the vapor is thereby brought into contact with the oil at the surface of the bubble, and equilibrium between an additional amount of the vapor and the oil is realized. Consequently, for increased plate efficiency, the bubble in passing through the liquid should be deformed as much as possible.

Ways of Accomplishing Deformation of Bubble: The deformation of the bubble passing through the liquid can be accomplished in several ways. The bubble can be forced violently through the slots or holes in the bubble cap into the liquid. This violent contact of the vapor with the liquid causes the bubble to be deformed by friction during its passage through the liquid and additional contact will be obtained. If the caps of a cap-type plate are placed reasonably close together, the bubbles passing through the openings of one cap are thrown violently against those passing through the openings of adjacent caps, and will suffer considerable deformation. By the violent agitation of the liquid on the plate, drops of the liquid will be carried into the vapor space and these drops of liquid in contact with the vapor will tend to reach a state of equilibrium with the vapor, as do the bubbles of vapor in the liquid.

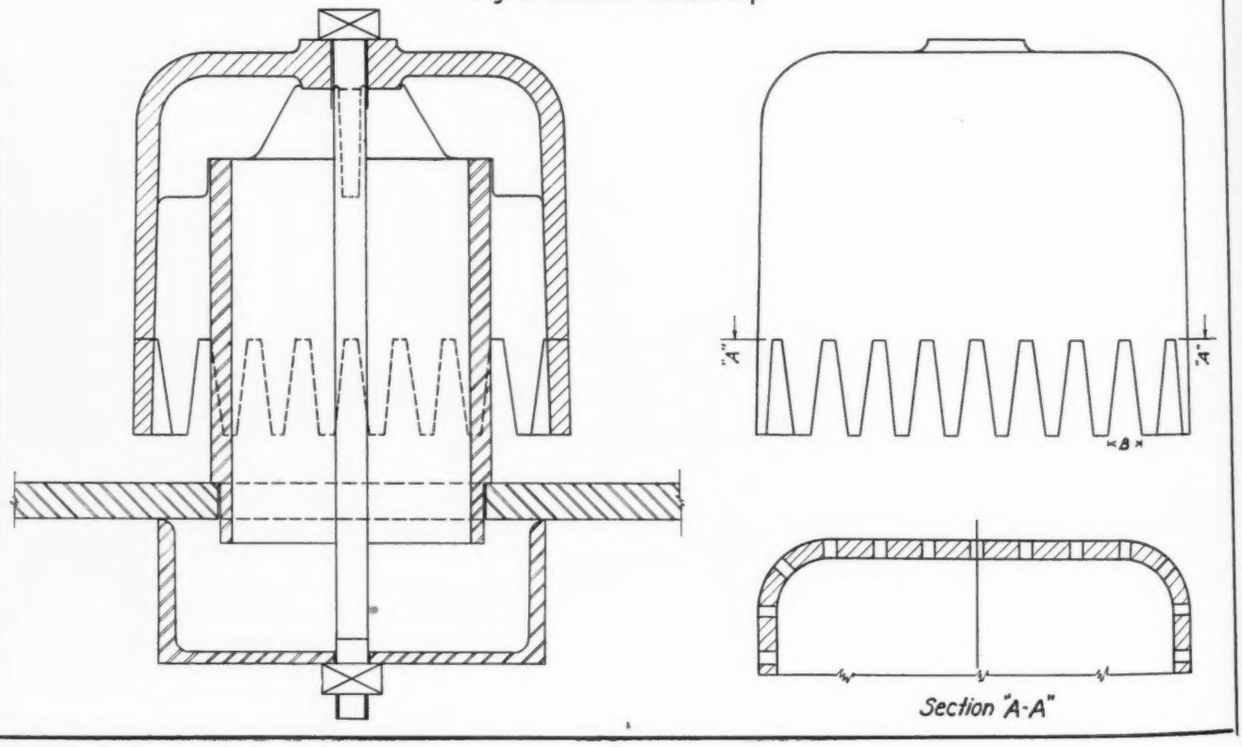
Maximum Vapor Velocities: Both field and laboratory tests have shown that the efficiency of a column increases with an increase in vapor velocity until the point is reached at which excessive quantities of the liquid are forced off the plate and the area of contact is reduced, whereupon the efficiency decreases. Practically, this point is that at which the liquid is carried from one tray to the one above.

Collusion of Governing Factors: It was previously shown that the greater the time of contact of the vapor and the liquid, the greater the plate efficiency. It was also shown that greater efficiency could also be obtained by increasing the velocity of the vapor, accomplishing new deformations of bubbles, which in turn would decrease the time of contact. The latter is governed entirely by the pressure drop permitted and by the carrying of liquid from one tray to the next. This latter consideration is in turn governed by the spacing of the plates, which will control under practically all circumstances the vapor velocity and restrict it to such a figure as to give ample time of contact between the liquid and vapor, consistent with a depth of liquid being maintained on the plate.

Pressure Drop in Fractionating Columns: Upon the height of the caps

(Continued on Page 57)

Fig. 1. Detail of bubble cap



(Continued from Page 54)

and the distance between them depend the depth of liquid on the plates and the velocity of vapor through the column. The pressure drop between any two plates of a column is a function of three things:

1. The depth of the liquid on the plate.
2. The velocity of the vapor through the cap slots.
3. The friction of the vapor passing through the slots and the liquid.

Therefore, the total pressure is the sum of the pressure due to the static head of liquid above the center of pressure in the opening of the slot, plus the velocity head of the vapor, which can be calculated from the expression:

$V = c\sqrt{2gh}$, where
V = velocity, ft. per sec.
c = constant, 0.30
g = acceleration due to gravity, 32.2
h = static head plus pressure loss due to friction.

Experiments have shown that the pressure loss through orifices under velocities less than 100 ft. per sec. is very small. As cap velocities or slot velocities are ordinarily 14 to 20 ft. per sec., the pressure loss due to friction can be neglected for all practical purposes. It should be remembered that the static head, h, is not the total depth of the liquid on the plate, but rather the distance from the surface of the liquid to the center of pressure of the cap slots. This latter value is also a function of the volume of gas passing through the slot; as the velocity of the gas increases, the liquid level is lowered.

Values of "c" for different types of slotted caps vary from 0.26 to 0.33, consequently, 0.30 is taken as a fair average. Suppose it is desired to have a 1.60-lb. pressure drop through an absorber having 16 trays, calculate the allowable velocity:

P through tower = 1.60 lb.
1.60/16 = 0.10 lb. per plate
$V = 0.30\sqrt{2gh}$

Using a molecular weight for the gas passing and atmospheric conditions:

30/380 = 0.079 lb. per cu. ft. (Density of gas at 14.67 lb. and 60 deg. fahr.)
$h = 0.10/0.079 \times 144 = 182$
$V = 0.30\sqrt{(64.4 \times 182)}$
$V = 0.30 \times 108 = 32.40$ ft. per sec.

The cap velocity of 32.40 ft. will give a pressure drop of 0.10 lb. per plate when passing a gas of a molecular weight of 30 and under atmospheric pressure and 60 deg. fahrenheit. When using that temperature, the figure of 380 is used, but if 32 deg. fahr. were used, 359 would be substituted, as has been previously brought out.

Make the same calculations when operating under a pressure of 30 lb. gauge and an average temperature of 85 deg. fahrenheit.

30/380 = 0.079 lb. per std. cu. ft., as above.

$$0.079 \times \frac{(460 + 60)}{(460 + 85)} \times \frac{(14.67 + 30)}{14.67} =$$

$0.079 \times 520/545 \times 44.67/14.67$
= 0.230 lb. per actual cu. ft.
$h = 0.10/0.230 \times 144 = 62.6$
$V = 0.30\sqrt{(64.4 \times 62.6)}$
$V = 19.02$ ft. per sec.

It can readily be seen that the maximum allowable velocity, or, conversely, the pressure drop through any tower can be calculated if the necessary factors are known.

EDITOR'S NOTE: Shell velocity in towers will be discussed in an article to appear in a later issue.

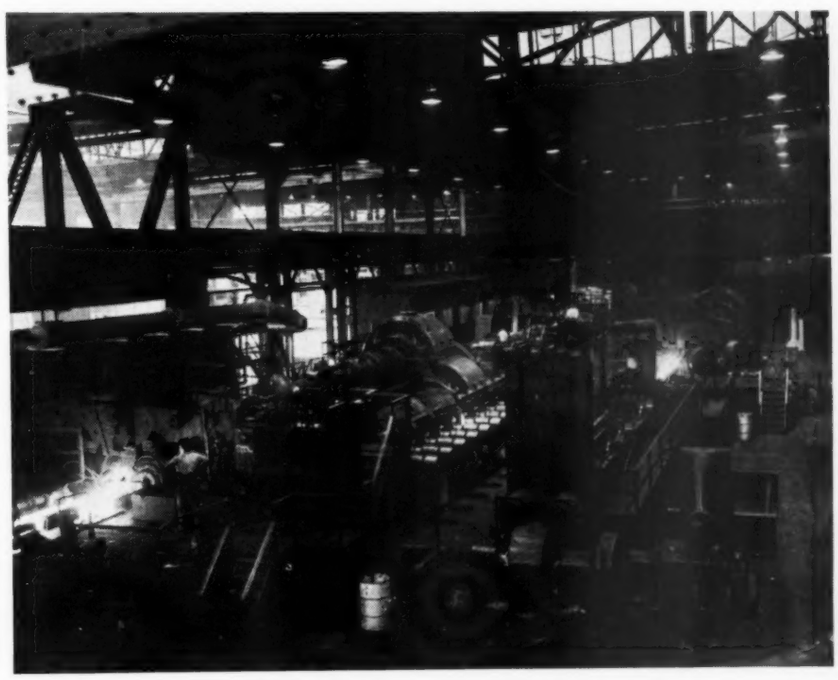
New Seamless Pipe Mill Built at Youngstown Sheet and Tube Plant

A NEW mill for making 4½- to 14-in. seamless pipe was recently placed in operation at the Youngstown, Ohio, plant of The Youngstown Sheet and Tube Company.

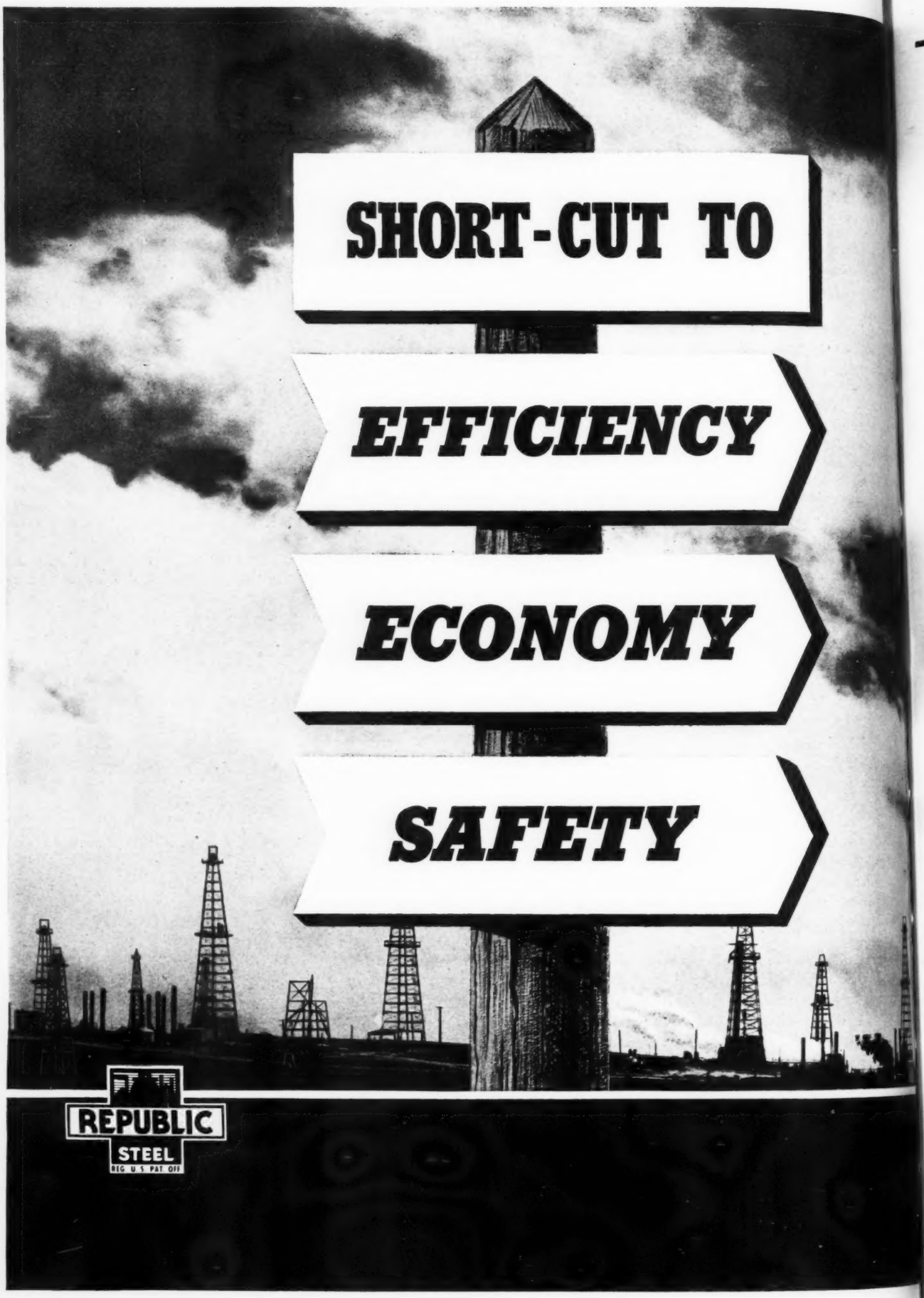
The new mill is part of a general development and improvement program recently completed in Youngstown Sheet and Tube's seamless pipe division, which included the installation of a new 35-in. rounds mill for rolling round pipe billets, two huge "peelers" that automatically "skin" steel billets to remove surface defects, two new 50-ton-per-hour billet heating furnaces, and two new pipe piercing mills that are masterpieces of engineering ingenuity.

Latest developments in design are incorporated in all the new equipment, from blooming mill to automatic pipe length recorders, which features precise automatic control of operations. The new mill has a rated capacity of 300,000 tons per year.

The steel used in the manufacture of pipe in the new mill is especially-selected open-hearth steel. Ingots of this special steel are reheated in a battery of 32 soaking pits and rolled into blooms on a recently reconditioned 40-in. blooming mill.



General view of the new tube piercing units



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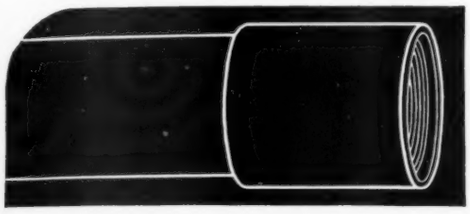
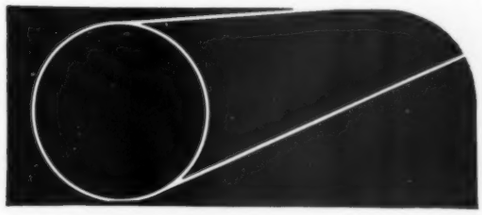
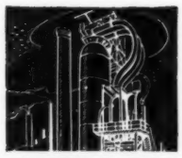


REPUBLIC CASING AND TUBING
LINE PIPE
MERCHANT PIPE



REPUBLIC ALLOY AND CARBON STEELS



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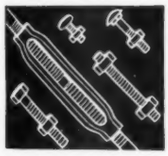
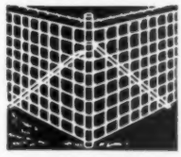


REPUBLIC UPSON QUALITY HEADED AND THREADED PRODUCTS

NILES STEEL SHIPPING CONTAINERS
TIN PLATE



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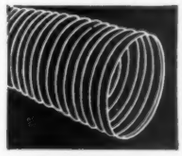

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The finished bridge on the pipe line across the canal on the Casper-Alcova project

Outer pipe prevents leaking oil from polluting irrigation water and supports bridge for line-walker

Unusual Pipe-Line Crossing Over Irrigation Canal in Wyoming

By H. W. KEYSER

PIPE-LINE crossings over water courses in the semi-arid regions of Wyoming present engineering problems peculiar to this type of territory. The Sinclair Wyoming Oil Company's 8-in. trunk line from the Salt Creek field to the refinery at Parco, Wyoming, crosses the highline canal of the Casper-Alcova or Kendrick reclamation project. At this crossing it is essential that no oil be allowed to pollute the water, which is used for irrigation. The canal is about 75 ft. wide and 15 ft. deep, and the sides slope steeply, so that it is almost impassable even when empty. As the line "walker" rides a horse while inspecting the line, it was necessary to construct a substantial bridge to support the weight of the pipe line and also of a horse and rider. A unique solution of both problems was devised by the company engineers.

The pipe line is almost parallel with the canal near the crossing. By a series of 13 wrinkles the pipe was bent through an angle of 80 deg., and an S-curve formed by wrinkle-bending raised the line from the level of the ditch to the edge of the canal. This was the first wrinkle-bending performed in Wyoming. A heavy-duty gate valve was placed in the line at each end of the bridge to provide complete control should the line break. Above the canal the 8-in. pipe line was enclosed in a 10-in. pipe projecting several feet beyond the canal banks and open at both ends. Should the 8-in. pipe line break, any lost oil would drain through the 10-in. pipe to the ground beyond the canal bank, and not into the canal. The pipe line supports only its own weight.

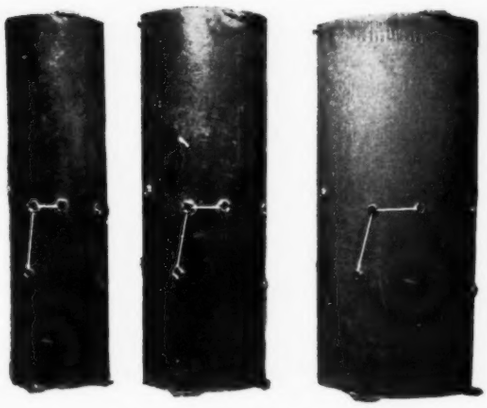
The 80-deg. wrinkle bend and turn to bring the line from ditch level to crossing level

Two concrete piers were constructed in the canal by the Reclamation Service. They are six ft. wide at the bottom, four ft. wide at the top, and 12 in. thick. In the top of each is a cradle for the pipe line. The 10-in. pipe rests on the piers and the canal banks and supports the bridge. Floor supports of 4-in. angle iron were welded to the pipe. Uprights of standard 2-in. line pipe were welded to the floor supports to support the side railings, which are made of discarded sucker rods welded to the uprights. Flooring of 2-in. planks was laid on the angle-iron floor supports. This bridge should require virtually no upkeep, and any necessary repairs could readily be made by the pipe line crew. With the exception of the angle iron used for floor supports, the entire bridge was made of salvaged material, so its cost was small.

At another crossing the 8-in. pipe line was enclosed in a 10-in. pipe, but no bridge was built as there is a highway bridge nearby. The 10-in. pipe is not open at the ends but is welded to the pipe line, and valves are provided at each end to permit draining and testing for leaks.

TRATION

RIGHT
A clean hole straight through three strings of cemented casing. This test set-up consists of 6⅝" 26# inside 8⅝" 36# inside 10¾" 40# Grade "C" Casing. This makes up 1.135 inches of steel penetrated plus 1.262 inches of cement, a total of 2.397 inches. The bullet was recovered and is shown at the left.

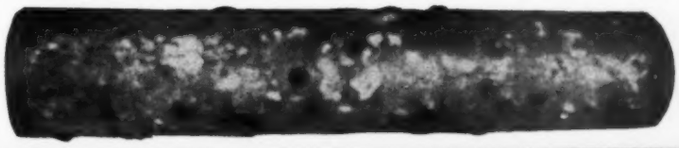


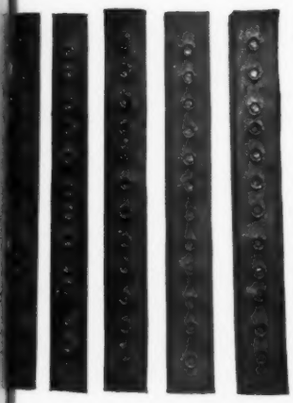
LEFT
Welded straps held this casing concentric for penetration test shots. The clean holes straight through 6⅝" 26# inside of 8⅝" 36# inside of 10¾" 40# Grade "C" Casing placed to simulate actual well condition shows that the perforations are made without splitting or distorting the casing.

ABOVE
Twenty-three shots through a 5½" OD screen, from 7727' to 7718' produced 22 holes. The twenty-third bullet penetrated far enough to bring it flush with the inside of the screen. The point was found to be broken off flush with the outside of the screen. A punch and hammer were required to remove this fragment.

BELOW
105 holes in this pulled liner out of 107 shots. One bullet stuck in a collar with only partial penetration and one bullet unaccounted for. Perforations were made between 5650 and 5660 feet for production on a new well through 7" OD 26# Casing and 5" 18# Liner.

ABOVE
From the first well to be Gun Perforated in the Rhodessa, Louisiana Field, the liner was pulled January 7, 1938. The "lap-weld" type pipe is in perfect condition after perforating.

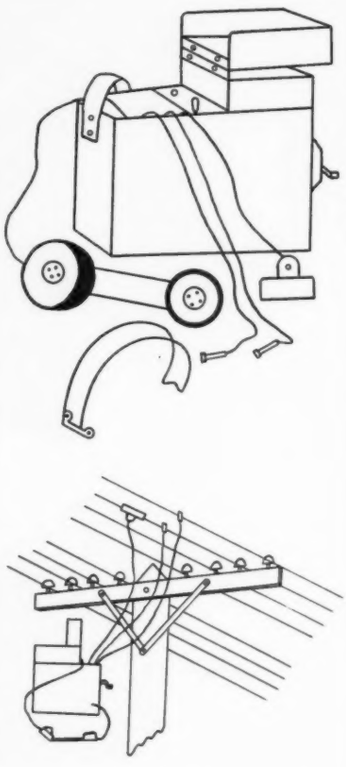




LEFT
The solid block of steel offers more resistance to penetration than the same thickness of steel in the form of casing. Shots into these test bars average 1.450 inches, more than enough to bury the bullet completely.

Tomorrow's Tools Today

TECHNICAL OILFIELD SERVICES



Top—Lineman's test set
Bottom—Method of connecting lineman's test set

Locating and Correcting Trouble in Telephone Lines

Shorts, grounds, crosses, and opens must be found and repaired quickly to maintain service over communication systems

By CLARENCE A. ANDERSON

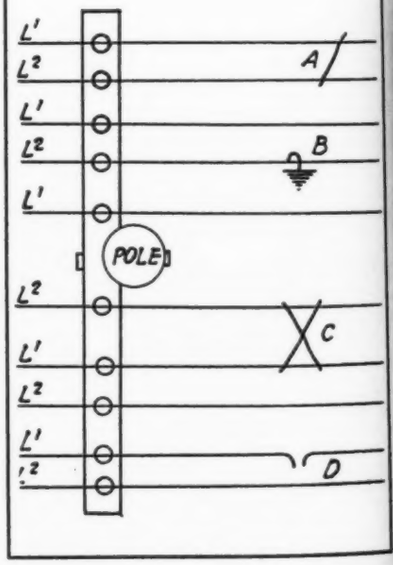
COMMUNICATION lines are vitally important to pipe line companies. Pipe lines that convey oil, gasoline, or gas many miles must be under constant supervision. Communication departments have been established to maintain operation of the dispatchers' lines at a minimum loss of circuit time.

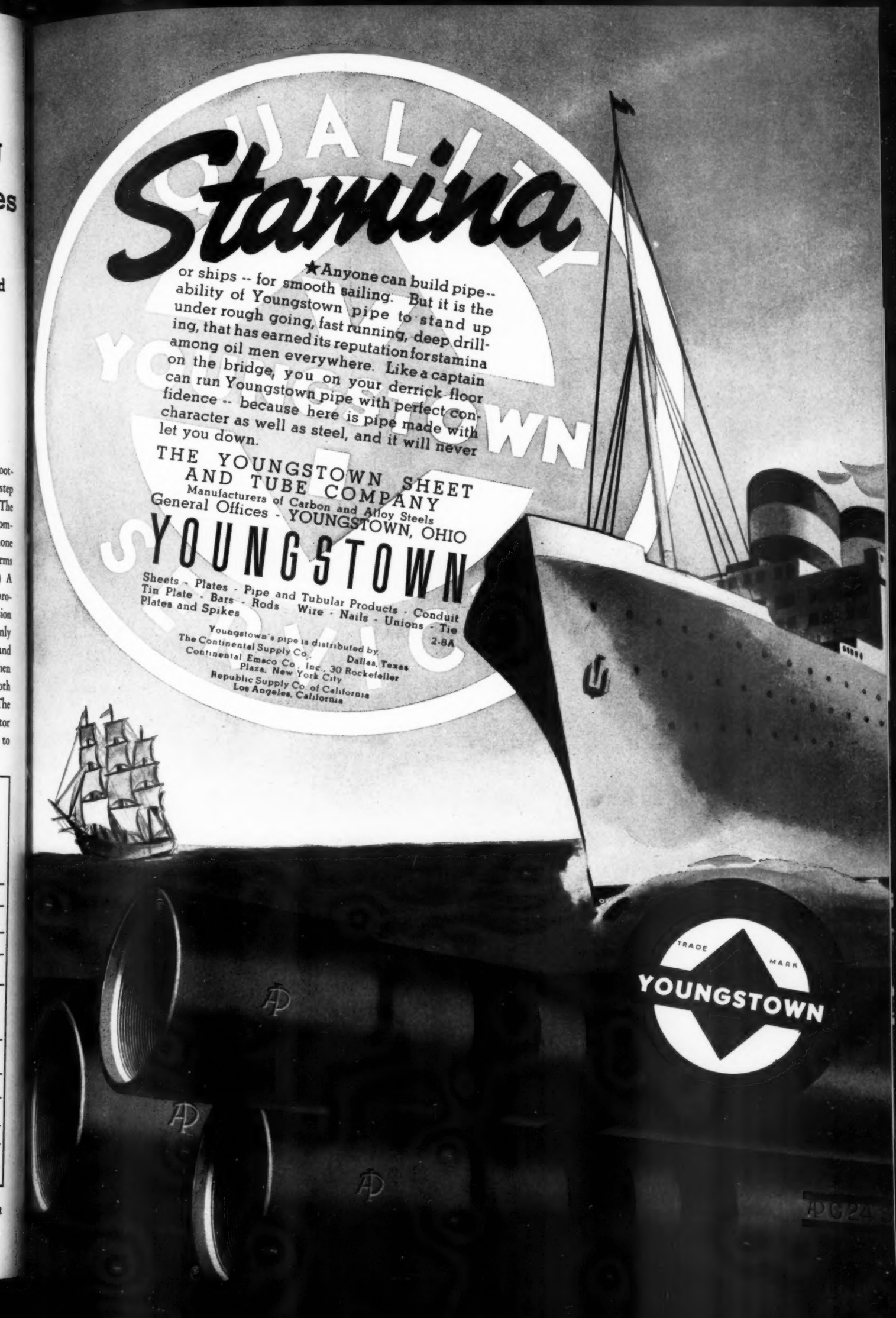
In early days pipe line companies used the telegraph as a regular means of communication. Later, the telephone was adopted but its transmission limitations necessitated dividing the system into sections, messages being manually relayed to points farther along the line. Today, however, owing to the telephonic repeater, these sections are connected and it is common practice to converse over circuits two or three thousand miles long. As business expanded, increased demand for communication service made it necessary for the companies to add circuits to their system. In order to obtain more working circuits in a minimum amount of pole space, the phantom circuit was adopted. This provided extra circuits from a combination of outside circuits. Consequently, the incapacity of one of the outside line circuits could affect the operation of an "office made" circuit, which might be dependent upon it for service. It thus becomes evident that any method of reducing time required for clearing trouble on outside lines is valuable to any company operating important communication lines.

Until a few years ago it was customary for the man at the test board to do virtually all the testing in locating trouble on outside lines. Linemen, or trouble shooters as they are commonly called, were assigned jobs and given orders to call-in for a test when trouble did not show-up at the location indicated by the office instruments. In making a long-range test on open wire using office instruments, the location of trouble can easily fall short of accuracy owing to a number of factors that may enter into the case. Therefore, it was customary to send a trouble shooter a certain distance along the line to give the test board a check test. This sometimes proved detrimental to service, especially during that part of the day when traffic was at the peak. If a physical circuit was in trouble, the trouble shooter would have to call-in on a working circuit and possibly a phantom circuit would have to be pulled-down for the test. Furthermore, the time of two men was required in making the test.

The present-day method of shooting trouble on outside lines is a step forward in line maintenance. The trouble shooter is provided with a combination test set and portable telephone with which he can trace various forms of trouble to their source. (Fig. 1.) A flexible, light-weight hand set is provided to supply efficient transmission on the long haul circuits commonly operated by oil companies. A head band can be attached to the handpiece when the lineman desires the use of both hands in operating the device. The main part of the test set is a detector coil, which the lineman can attach to

Fig. 2. (A) Short. (B) Ground. (C) Cross. (D) Open




QUALITY
Stamina
★Anyone can build pipe-- or ships -- for smooth sailing. But it is the ability of Youngstown pipe to stand up under rough going, fast running, deep drilling, that has earned its reputation for stamina among oil men everywhere. Like a captain on the bridge, you on your derrick floor can run Youngstown pipe with perfect confidence -- because here is pipe made with character as well as steel, and it will never let you down.
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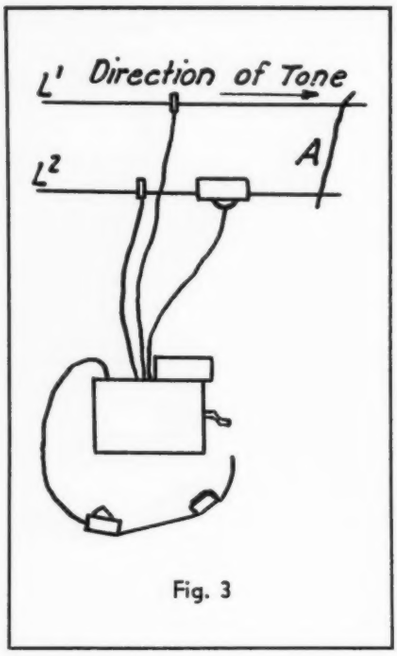


Fig. 3

the line to ascertain the direction of the fault. The procedure is simple. If, for instance, the location of the fault is "north," he proceeds in that direction and makes tests until it shows "south." Thus, he knows that the position of the fault is between the last "north" indication and the first "south" indication. The trouble zone can be reduced to a single span of wire, as is sometimes done when small magnet wire finds its way into the telephone lead and defies detection by the naked eye.

The man at the test board generally

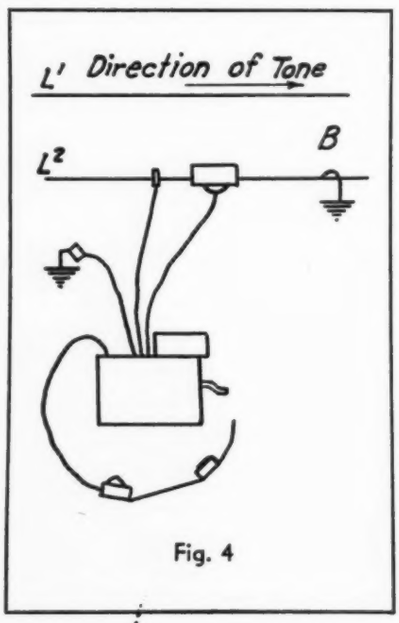


Fig. 4

makes a survey of his lines using his office instruments and, upon finding circuits in trouble, assigns the job to the trouble shooter, giving him the approximate location. The trouble shooter can then trace the trouble by a test set and usually does not have to call-in until the circuit is cleared.

Most outside line troubles fall into four classes, namely: shorts, grounds, crosses, and opens. (Fig. 2.) Trouble may be solid or intermittent; if the latter, (generally called swinging trouble) the lineman must test more carefully to determine the location while the fault is in. Using the test set he can "ring in" faults readily, owing to a characteristic electrical wave, which is a particular feature of the set. Fig. 3 shows how the set is connected directly to a pair of wires of a circuit in testing for a "short." The detector coil is clamped over either wire of the pair, 16 or 18 in. from the test clip. Fig. 4 shows how in testing for a "ground" the set is connected between the line wire and ground, the detector coil being clamped over the line wire. In testing for a "cross" (Fig. 5) the test set is connected between one wire of a circuit and the affected wire of another circuit. The procedure is then the same as in testing for a "short". In every test the lineman turns the generator crank while listening in the receiver for the generator tone. He will hear this tone when the detector coil is on the same side of the test clip as the trouble. For example, as before stated, if he clamps the detector coil on the "south" side of the test clip and hears no tone when the generator crank is turned, he places the detector coil on the other side of the clip. If the test tone is loud, the trouble is "close in," and if it is faint, the trouble is "far out." Most linemen of experience can gauge this tone and clear their trouble after two or three tests. In testing for an "open" (Fig. 6) a short is placed on one end of the circuit and the lineman will follow the test tone to the point where it ceases. The detector coil is clamped over the test cord instead of over the line as in previous tests. There is, however, a lamp in the test set, which can also be used for "open" tests.

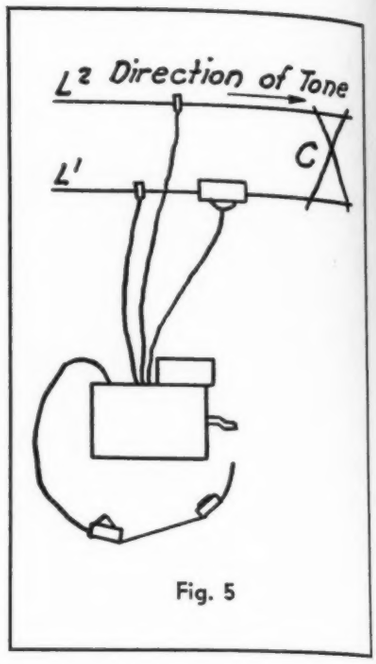


Fig. 5

When a trouble shooter starts on a job, it is his aim to clear the trouble in the minimum amount of time. When a test set is used, it is not necessary to follow the lines directly, which is sometimes difficult. A lineman can use the main roads and drive to the lines at convenient points to ascertain between which two places the trouble is situated, covering the line in detail for that distance only. Furthermore, a troubleman has facilities for testing for various other forms of trouble that may hinder service, such as moisture, leakage in drop wire, trouble in lightning protectors, and failures in ground rods. The lineman soon adjusts himself to locating almost any kind of trouble.

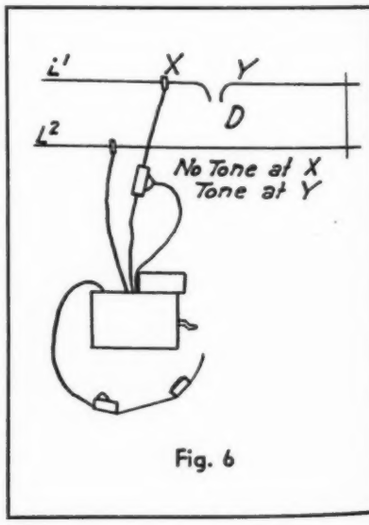


Fig. 6

The line was re-laid by the "stove-pipe" method

By
FRANK H. LOVE

Features of Pipe Line Reconditioning Work

Traveling-type machine that coats and wraps pipe in a single operation and pipe-straightening apparatus, both new, among factors of interest in extensive project in Texas

THE Magnolia Pipe Line Company's reconditioning program involving a part of its system in Texas has been completed. The work began at Hildebrandt Bayou, near Beaumont, Texas, and 30 miles of 8-in. pipe was taken up between that point and the Hull station. A central yard, or rack, was established at Grayburg, to which the pipe was transported for cleaning, reconditioning, beveling, straightening, and double-jointing. Sixteen and one-half miles of the pipe was relaid from Grayburg to a point three and one-half miles west of the Hull station.

The procedure for taking up the pipe involved the locating of the line by a radio pipe-finder, after which it was stripped by two ditching machines, each equipped with a special stripping shoe radiused behind the digging wheel to allow the latter to dispose of the dirt completely. The shoe rides on the pipe, encircling the upper half. On each side are cutters that remove the dirt from the top half of the pipe, the pipe thus coming out of the ditch free of strain and ordinarily without bending.

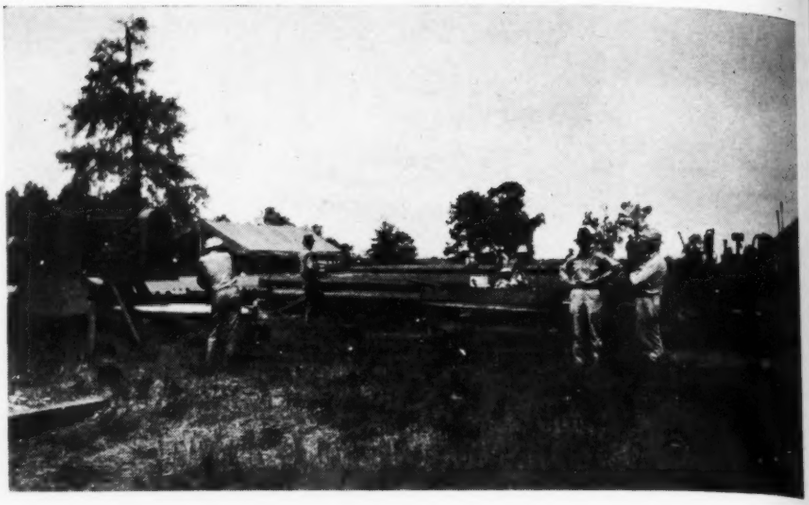
After the pipe was stripped two tractors, one equipped with a sideboom and front-end winch and the other with a sideboom only, were employed to raise the pipe, placing it on skids over the ditch. The pipe was placed high enough to permit the use of a cleaning machine of the traveling type for removing the heavy dirt. When road crossings or other drag sections were encountered the line was stripped and one of the tractors held the pipe with its sideboom and cradle while with its front-end winch it pulled the pipe back through the cleaning machine, cleaning the entire drag section.

After the pipe was cleaned the collars were split by using old welding rod and a 400-amp. electric welder. A tractor and sideboom then broke out the joints at the collars, it being necessary occasionally for the swamper to strike a collar with a sledge to help loosen it.

The pipe was hauled to Grayburg, where all crooked pipe was straight-

General view of the central reconditioning yard

Stationary-type cleaning machines in operation



ened by a two-stage, triplex, motor-driven straightening machine. This machine is extremely powerful and straightens pipe with exceptional speed, 25 to 30 joints an hour being a conservative amount. Pipe to be straightened is picked up by a tractor equipped with a sideboom and placed in the machine, the foreman sighting the pipe to determine at what points pressure is to be applied and to decide when the pipe has attained straightness. Assisting the foreman were three men in addition to the machine operator.

The next step in the reconditioning procedure was to remove collars and bevel the pipe, this being done in one operation, after which the pipe was further cleaned by two stationary-type machines. Rust was removed from pits by the use of small air hammers and hand tools, the deep pits then being spot welded, and the spot welds smoothed by an air grinder. Finally, the 20-ft. joints of pipe were welded into lengths of approximately 40 feet.

At the central yard a supply tent was provided, as well as a complete blacksmith shop. The latter was equipped with electric drills and grinders. Here all knives used in the cleaning machines, the "pecking" tools, scaling tools, etc., were fashioned and sharpened. Other equipment provided at the central yard was a 100-lb. generator to provide gas for beveling, pipe cutting, and hard-surfacing knives, as well as 400-amp. welding machines, and two air compressors. The latter were manifolded and supplied the air required by the grinding tools and air hammers.

As the pipe was removed from the ground the old ditch was backfilled and in relaying the pipe after it had been reconditioned a new ditch was dug. The pipe was relaid by the "stovepipe" method, one tractor being used to place the pipe for tacking and the running of the stringer bead. For this welding two 200-amp. machines were employed; five 300-amp. machines, each mounted on a trailer and moved by drawbar tractors, were used in completing the welds.

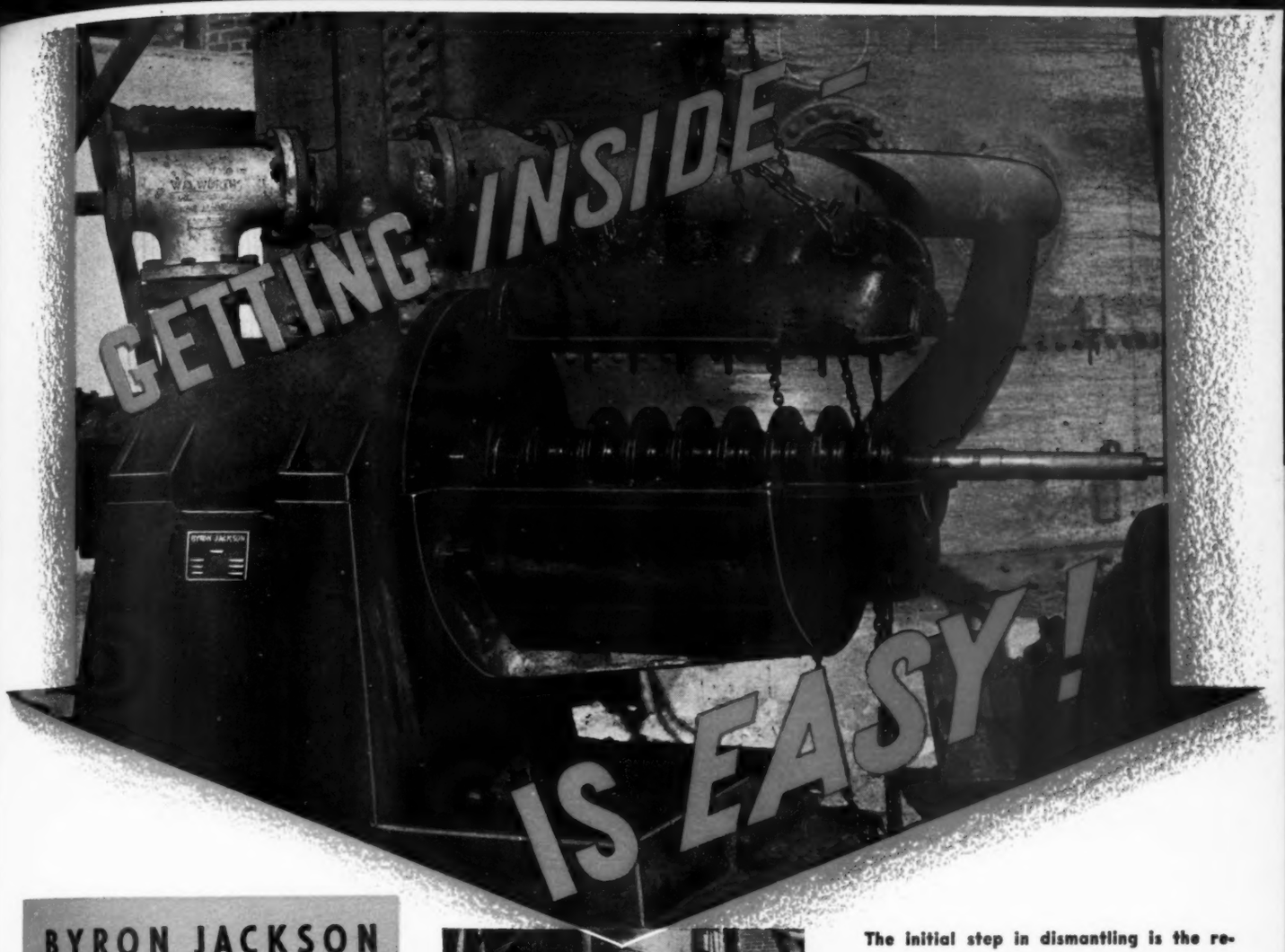
After the pipe was welded a traveling-type cleaning machine was again passed over it, the pipe first being soaked in kerosene. When the machine had traversed the pipe for some distance it was moved back and rerun, gasoline being placed on the pipe to dry the kerosene. The pipe then was repecked with pecking tools, a priming coat applied by the "rag" method, and the coating and paper wrapping applied by a new combination coating and wrapping machine, which weighs approximately 600 lb., is of the hopper type, and has a semi-doping shoe. The coating is poured into the hopper, from which it flows over the pipe. The material not adhering to the pipe is circulated from a drip-pan back to the hopper by a rotary pump. The pump is driven by a small gasoline engine, which also provides the power to propel the machine along the pipe, and drives the arms and spools behind the machine. A tractor and cradle hold the pipe for the coating and wrapping machine and move ahead of it. Behind the machine cold paint was applied by the "rag" method and kraft paper applied by hand. The pipe was lowered-in immediately behind the machine, occasional slack loops being held up. The ditch was then backfilled, the slack loops being lowered and covered the following morning when cool and contracted.

A part of the line was protected against corrosion by a chemically-compounded grease-type rust preventive, the rest by a coating manufactured by the Magnolia Petroleum Company, the formula for which was prepared by E. A. Koenig of the Magnolia staff. The latter preparation consists principally of wax and asphalt.

After the work in the Grayburg yard was completed, a rack was established at Cleveland. West of the Cleveland station 14 miles of pipe was taken up and 12 miles relaid.

W. G. "Bill" Hanrahan, pipe line contractor, Dallas, Texas, has the general contract for the work. Joe D. Hughes was sublet the contract for hauling the pipe to the central yard and stringing it after reconditioning.

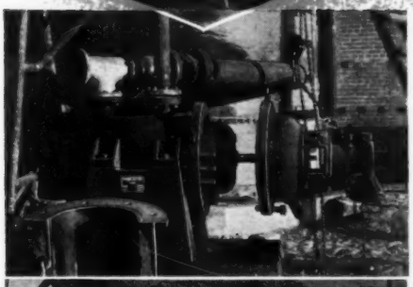
Straightening crooked joints of pipe

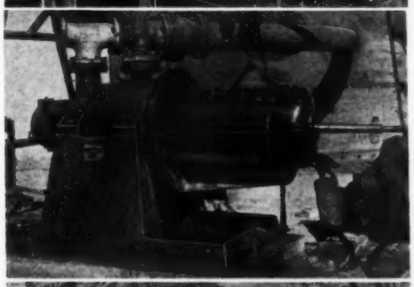


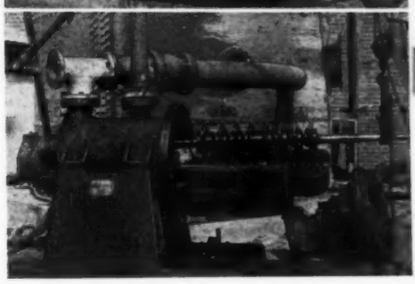
BYRON JACKSON DOUBLE-CASE HOT OIL CHARGING PUMPS

. . . . have the inner case split horizontally along the shaft centerline. Both halves of the case are easily withdrawn from the Outer Barrel because of the irregular section, with no close fits to become solidly "coked up" in service.

The split-case design permits the complete Rotating Element to be removed without dismantling it, and quick repairs can be made by the installation of a factory-assembled spare Element. Details, specifications and recommendations furnished upon request.







The initial step in dismantling is the removal of the End Cover and Bearing Housing, accomplished without disturbing or disconnecting Piping or Driver.

The Inner Volute Case and the Rotating Element are next removed in a *completely assembled unit*, the weight of which is being supported by the Dismantling Tray. See large illustration for the third step.

No need for field work on the Rotating Element now ready to be transported to the machine shop. The spare Rotating Element is simply dropped into place and the pump re-assembled.

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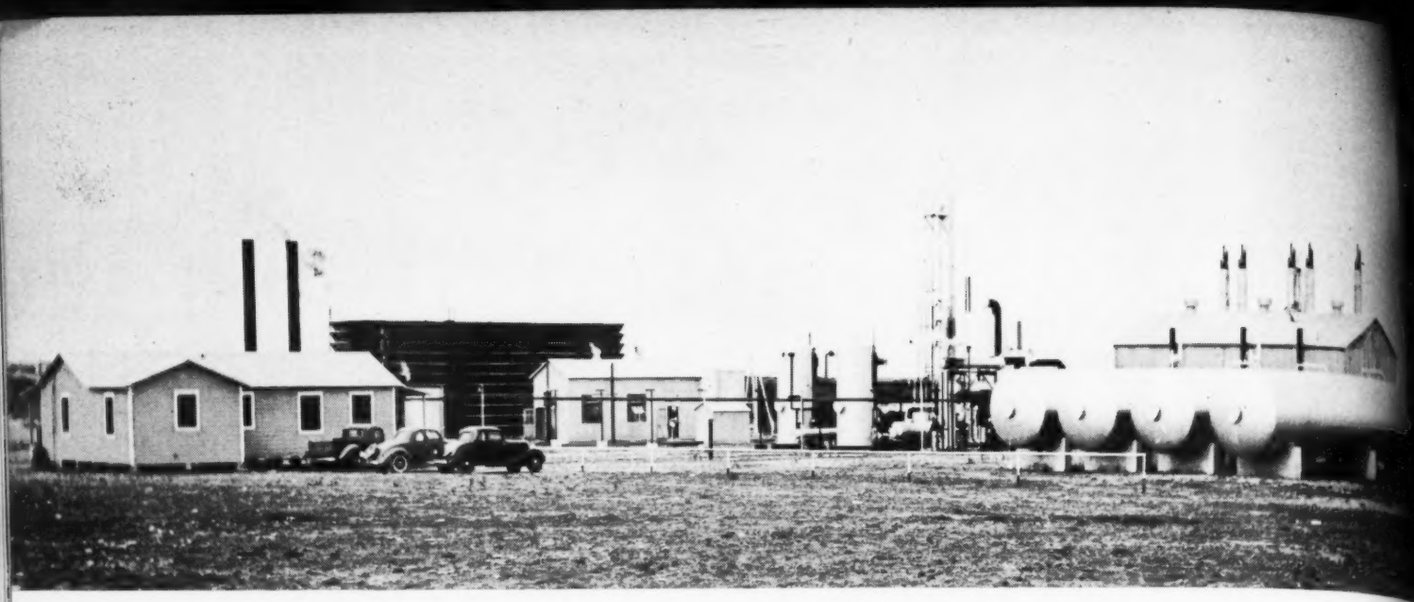


General view of Benavides gasoline plant of Duval Gasoline Company

Recovery of Natural Gasoline by Dehydration and Refrigeration of Casinghead Gas

New process involves dehydrating gas and cooling to a temperature low enough to liquefy all constituents, natural gasoline subsequently being recovered by the conventional means of stabilization

By DON S. WALLACE
Superintendent, Benavides Plant, Duval Gasoline Company

RECOVERY of natural gasoline from casinghead gas is being accomplished at the Benavides, Texas, plant of the Duval Gasoline Company by a process of dehydration and refrigeration. The plant is the first of its kind to be constructed.

Widespread interest has been manifest in this new type plant for the manufacture of natural gasoline. Briefly, the process involves the cooling of the feed gas, after dehydration, to a temperature low enough that all the desirable constituents are liquefied. From this liquid natural gasoline is subsequently recovered by the usual method of stabilization. The absorption process, employed in the conventional method of natural gasoline manufacture, is eliminated.

Since being placed in operation the plant has processed 6,500,000 cu. ft. of gas per day, manufacturing about 15,000 gal. of 18.0-lb. Reid vapor-pressure gasoline per day.

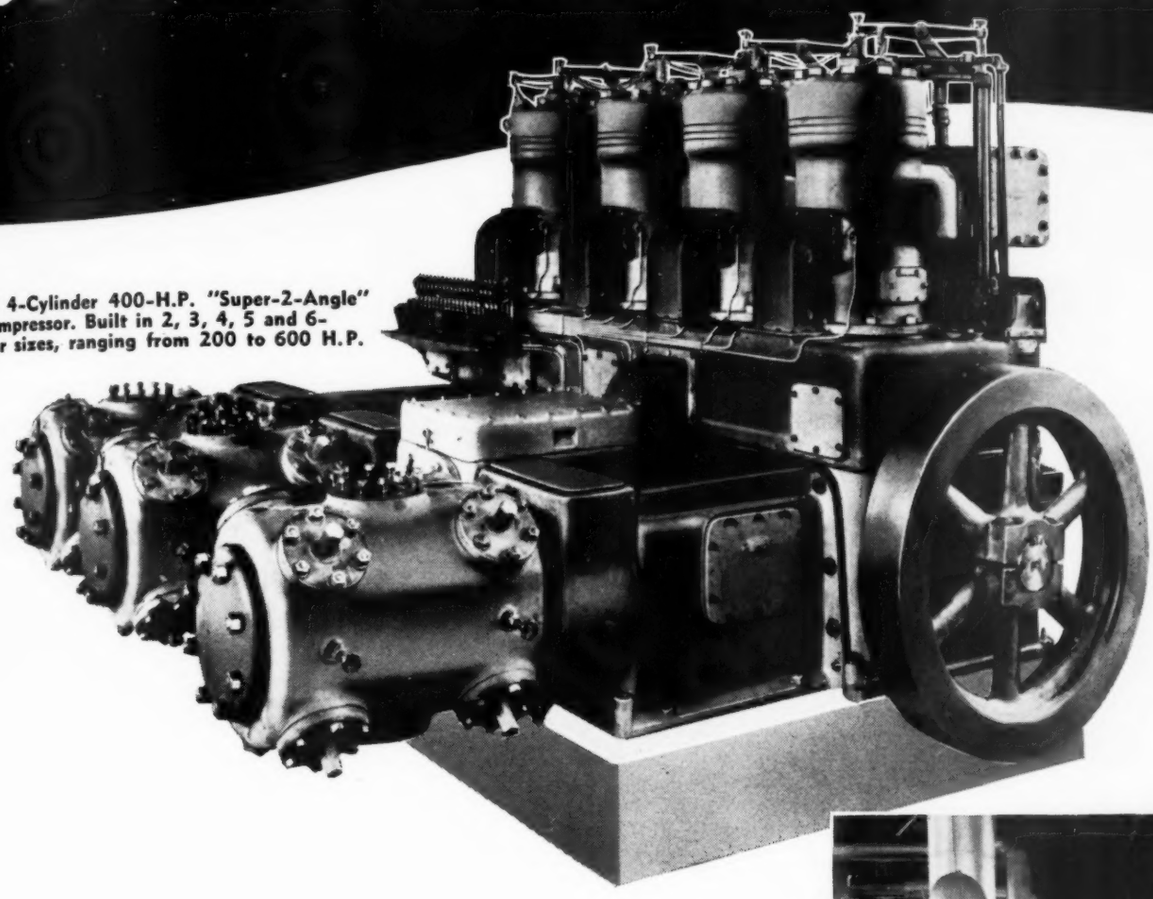
Processing Procedure

A gathering system, consisting of about 18 miles of pipe ranging in size from 6⅝-in. to 14-in., transports the gas from the Benavides field to the plant. The main line from the north is 14-in. pipe and the line from the south is 12-inch. Wet gas is received at the plant at about atmospheric pressure and is passed through a 5-ft. 5½-in. by 20-ft. horizontal scrubber for removal of liquids. The gas is then sent to three gas-engine-driven compressors where it is compressed to a pressure of 50 to 60 lb. gauge. At this pressure the gas is first passed through a heat exchanger in which the cooling medium is water, then through a second exchanger employing cold residue gas as the cooling medium. It leaves this exchanger at a temperature of 40 deg. fahrenheit. At this temperature a part of the heavy hydrocarbons and a considerable amount of the moisture are condensed from the gas. The liquids and gases are separated in a drum, the water being drawn off and sent to the disposal system and the liquid hydrocarbons pumped to the stabilizer.

From the separating drum the gas is passed through either of two parallel driers. It is here dehydrated to such a degree that even at a temperature as low as minus 50 deg. fahr. there is no condensation. The driers are filled with a granular material having a high absorptive capacity for water vapor. The driers are not used simultaneously. One operates for a period of 24 hours, being then removed from service and the other placed in use. From the idle unit accumulated water is removed from the absorbent. This is accomplished by passing through the drier a small amount of residue gas that has been heated by steam to a temperature of 325 to 350 deg. fahrenheit. The hot gas vaporizes the water and its passage through the drier is continued until the water is entirely removed. The absorbent is then cooled by passing through it unheated residue gas. Six to eight hours is required to remove the water from one of these driers, cool the absorbent, and have the unit ready to return to operation. The absorbent employed is one that has been in use for years in oxygen plants where water vapor removal must be more nearly complete than for natural gasoline recovery, as the temperatures in connection with liquid air are much lower. The material also is used for drying in thermal polymerization units. In both of these applications experience has shown that with proper usage the life of the material is virtually unlimited, there being no breakage or deterioration.

After removal of water in the driers the gas is cooled in an exchanger to a temperature of minus 35 deg. fahr.; the cooling medium in the exchanger is liquid propane vaporizing at about atmospheric pressure. The resulting mix-

NEW TYPE NATURAL GASOLINE PLANT *uses* CLARK "ANGLE" COMPRESSORS



CLARK 4-Cylinder 400-H.P. "Super-2-Angle" Compressor. Built in 2, 3, 4, 5 and 6-cylinder sizes, ranging from 200 to 600 H.P.

HERETOFORE, low-temperature cooling with propane gas has been confined to refinery use. Recently, however, propane refrigeration has been applied successfully in a new-type natural gasoline plant, at Benavides, Texas. The process involves freeing the gas of water, then cooling the gas by propane refrigeration to the required temperature for liquifying the natural gasoline.

In this new-type plant, CLARK "Super-2-Angle" Compressors are being used for compressing the natural gas, in a single stage, and the propane gas, which is subjected to two-stage compression.

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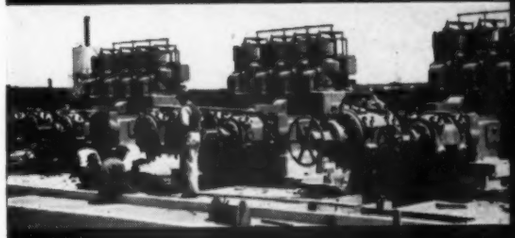
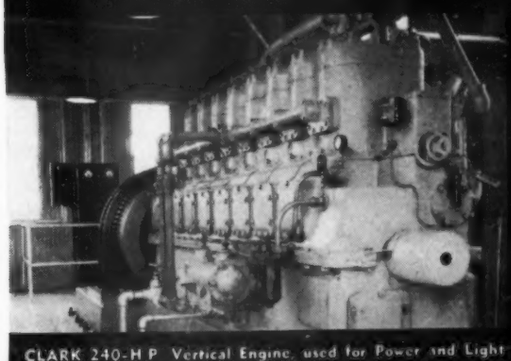
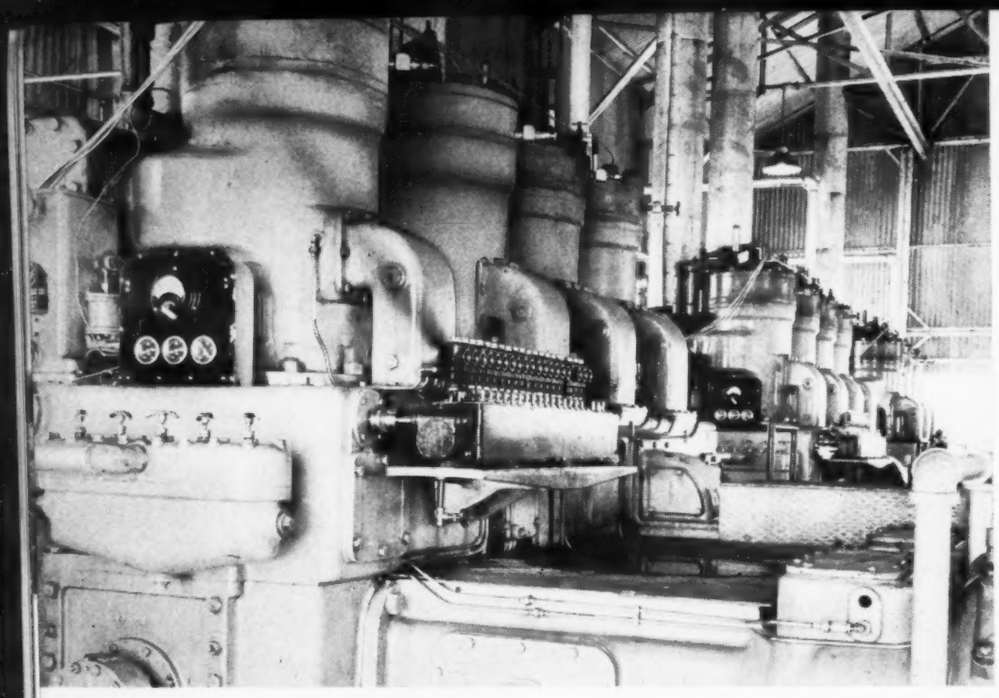
Interior, showing battery of CLARK "Angles"



View during installation of CLARK "Angles"



CLARK 240-H P Vertical Engine, used for Power and Light



Engine end of main compressor units. Lubricators, exhaust pyrometers, and battery ignition are shown

ture of liquid hydrocarbons and gases is separated in a drum. The cold vapors are taken from this drum to serve as a heat-exchange medium for cooling the feed gas. The cold liquids are pumped through a heat exchanger in which the liquid propane is cooled. They are then joined by the liquid hydrocarbons produced in the heat exchanger situated immediately ahead of the driers. The mixture of liquids thus formed is passed in a heat exchanger countercurrently to finished gasoline from the bottom of the stabilizer. The liquid is thus preheated, after which it is sent to a 20-tray stabilizer, at the base of which is the conventional steam reboiler.

Under usual circumstances the stabilizer is operated at a pressure of 175 lb. gauge. Overhead vapors from the stabilizer are partly condensed in a water-cooled condenser and the resulting reflux collected in a drum and pumped to the top of the stabilizer. The temperature of the stabilizer bottoms is reduced by heat exchange with stabilizer feed, and the bottoms are cooled further with water and then pumped to storage as finished gasoline.

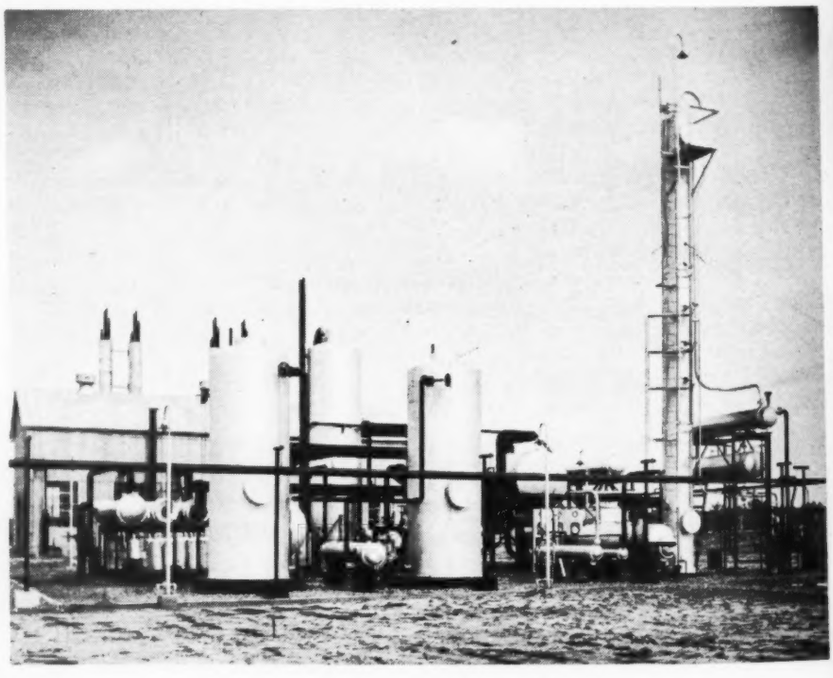
Refrigeration Cycle

The refrigeration cycle is a closed one, there being no direct contact between the propane and the gases being cooled. In this cycle the propane evaporates at about atmospheric pressure in the heat exchanger through which operating temperatures are maintained, it passes counterflow to the feed gas after the feed gas has been dehydrated in the driers. Before entering the compressors the propane vapor passes through a drum to prevent any entrained liquid from reaching the compressors. The propane vapor enters the compressors at 6-in. vacuum and is discharged at a pressure of approximately 200 lb. per sq. inch. After being condensed by cooling with water it passes to a small storage drum, from which the liquid propane is taken to be cooled by heat exchange with the cold hydrocarbons. The liquid propane is then further cooled by expansion to atmospheric pressure. It is then ready for use in the propane evaporator.

Main Compressors

The main battery of compressors was designed particularly for this job by the engineers of the Clark Bros. Company. They are extremely flexible in operation and the propane units are equipped with variable clearance pockets to operate over a wide range of suction pressures and to meet any condition necessary for extracting various grades of gasoline. The compressors were designed after a careful study of the various types of gas available and types of gasoline that the plant could make.

The main compressors consist of two 400-hp. and one 300-hp. angle-type units driven by 2-cycle, 14-in. by 14-in. vertical engines. The 300-hp. unit is direct-connected to one 25-in. low-stage and one 13-in. high-stage compressor cylinder both of which compress propane gas. The gas from the low-stage is discharged directly into the suction of the high-stage, there being no intercooling of the gas between stages. One of the 400-hp. engines is direct-connected to two 21-in. compressor cylinders for natural gas and one 18-in. low-stage compressor cylinder for propane gas. The other 400-hp. unit is direct-connected to two 21-in. compressor cylinders for natural gas and one 10-in. high-stage compressor cylinder for propane gas. The gas goes from the discharge of the 18-in. low-stage compressor cylinder for propane to the suction of the 10-in. high-stage cylinder without intercooling. The compressor cylinders for the natural gas operate at atmospheric suction pressure and a discharge pressure of 50 to 60 pounds. On the compressor cylinders for the propane gas the suction



Driers, in which the feed gas is dehydrated, are in left foreground; stabilizer at right. Noiseless-type mufflers can be seen protruding from top of main compressor building in background

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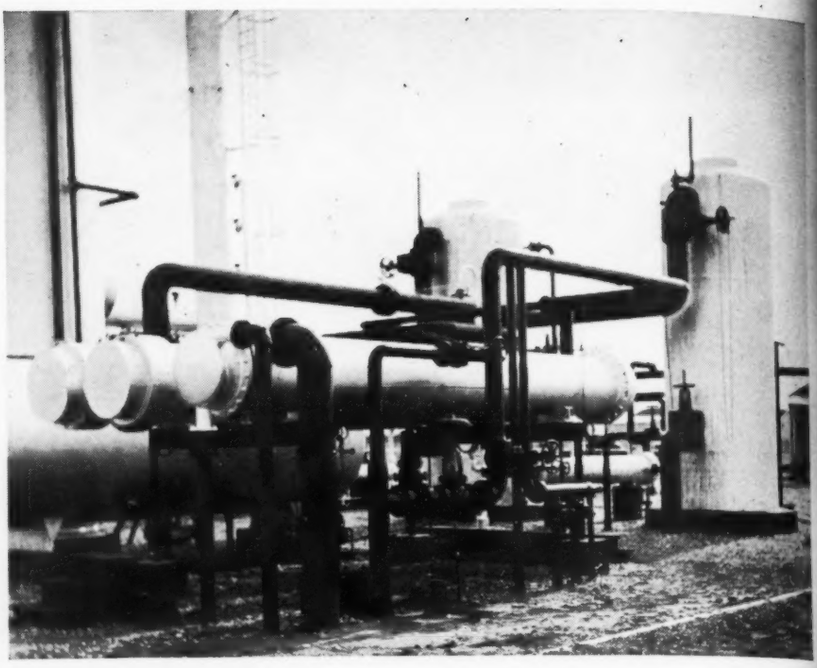


pressure is 6-in. vacuum and the discharge pressure approximately 200 pounds. Under ordinary operating conditions the propane cylinders of the 400-hp. units are not used, serving only as emergency equipment in event of trouble arising in the 300-hp. compressor unit for propane.

These right-angle gas-engine-driven compressor units are of comparatively recent design and embody features of both the vertical gas engine and the horizontal compressor. Power cylinders are vertical and the compressor cylinders horizontal. This design gives a good balance and effects smooth operation, and the compactness of the unit conserves floor space.

Each of the 400-hp. engines is equipped with two 10-in. exhausts extending through the roof of the building. The 300-hp. engine has one 10-in. exhaust. The mufflers on the exhaust are of a new design and are virtually noiseless. As shown in an accompanying illustration, each muffler consists of ten 2½-in. diameter pipes so arranged that the exhaust gas is discharged through them with minimum noise.

The gauge board in the main compressor building contains all instruments necessary for gauging gas suction and discharge pressures and temperatures.

A chain-hoist trolley of 2-ton capacity extends the length of the building to facilitate making repairs.

Force-feed lubrication is provided for all main compressors, oil being forced through the system by a mechanical force-feed rotary drive lubricator and a gear-type pump, both driven from the layshaft. The gear-type pump serves a double purpose, as it is used to pump oil for the oil-cooling system, which is incorporated in the lubricating system.

To lubricate the main bearings, crankpin bearings, and wrist pin bearings the oil is picked up in the crankcase by the gear-type pump and forced through a filter and oil-cooler. It is then sent under pressure to a header on the crankcase, and passes to the main bearings along the crankshaft. From the latter it flows through holes drilled in the crankshaft to the crankpin bearings, and through holes drilled in the connecting rod to the wrist pin bearings.

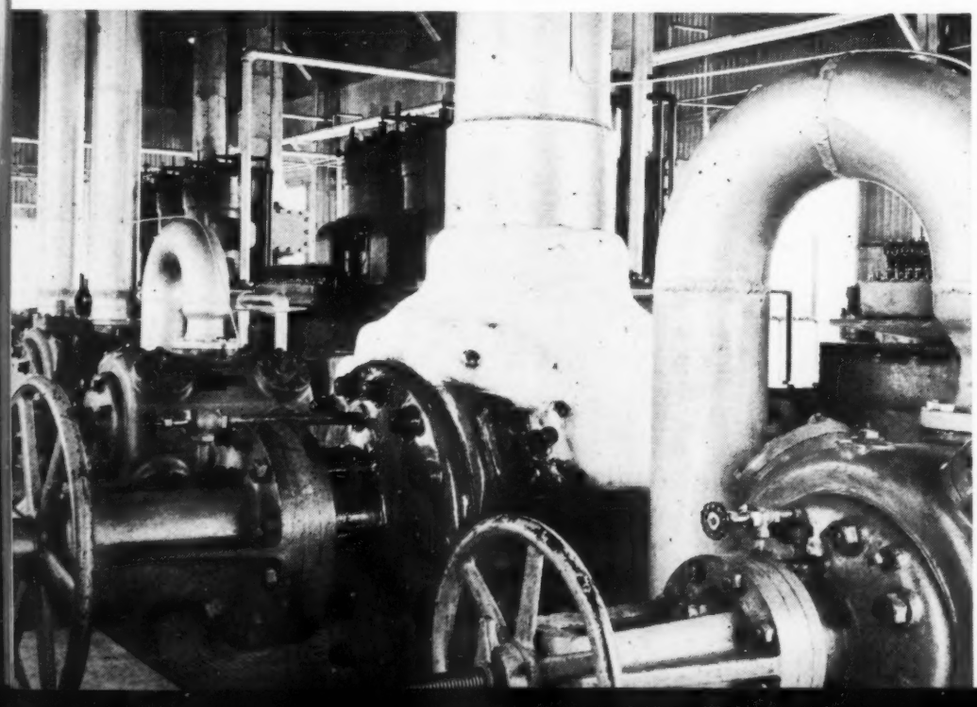
The force-feed rotary drive lubricator pumps oil to the power cylinders, the scavenging cylinders, the compressor cylinders, and to the metallic packing on the compressor piston rod.

The gear-type pump also pumps oil for the oil-cooling system. A feature of the compressor units is the system whereby all engine pistons are oil-cooled, the same oil used for lubrication being employed for this purpose. When the lubricating oil leaves the wrist pin bearing it passes to a space beneath the crown of the piston, through which it moves at high velocity, removing most of the heat from the piston. The oil then returns to the crankcase, is picked up by the gear-type pump and recirculated through the system.

Several advantages result from this system of lubrication and oil-cooling. Danger of contaminating crankcase oil is eliminated, and, as the lubricating oil is passed through coolers, low operating temperatures are maintained, as well as the lubricating quality of the oil. Cooling of the oil reduces the piston head temperature, eliminates sticking of piston rings, minimizes wear of cylinder walls, piston rings, and bearings, and improves compression by assuring a closer fit of the piston.

Water-Cooling

About 40 ft. east of the cooling tower is a water well 1196 ft. in depth, water standing within 100 ft. of the top. The well is flowed by gas-lift and a 50,000-gal. steel tank has been provided for water storage. The three water pumps are motor-driven. One pump takes suction from the base of the cooling tower and discharges to the distillation unit, one takes suction from the base of the tower and dis-



Propane compressor covered with ice

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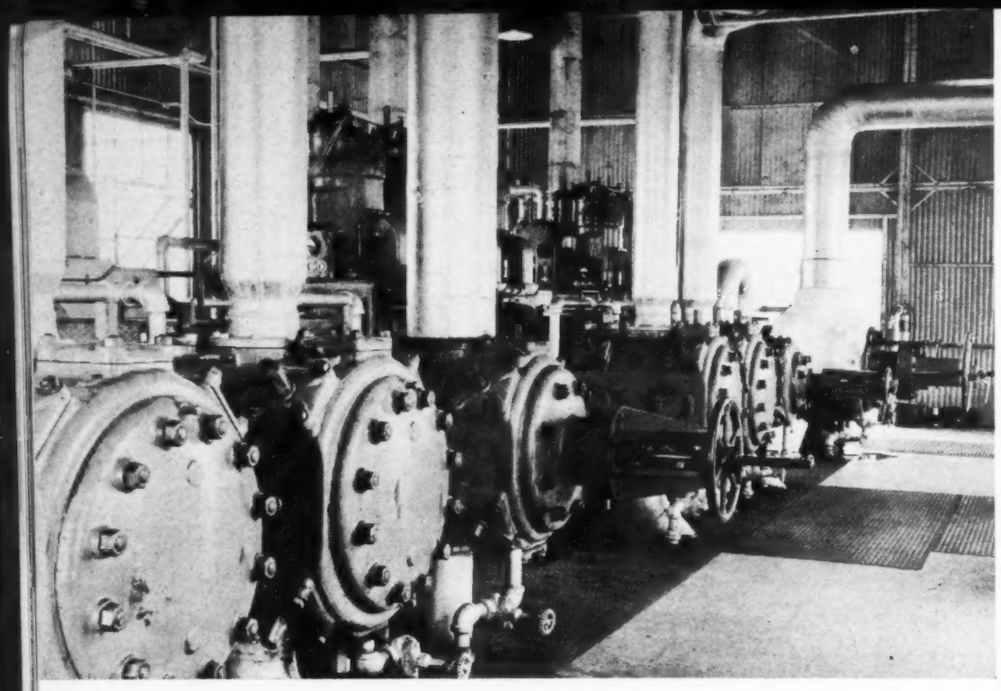


Compressor end of main engine-compressor units

charges to the engine jackets, and the third takes suction from the hot well and pumps over the cooling tower. In passing through the distillation unit the rise in temperature of the water is eight deg., and in cooling the engine jackets the increase in temperature is 18 degrees.

The cooling tower has a cooling capacity of 2400 gal. per min., of which, when operated at capacity, 700 gal. are for circulation to engine jackets and 1700 gal. for distillation.

Steam

Steam is utilized in the plant to heat gas for drier revivification, for stabilizer reboiling, and for the operation of small pumps. To generate the required steam two oil-country type boilers each of 85 b.hp. are provided, operating at a pressure of 150 lb., one of which is used as a standby. The steam-generating plant also has the usual accessories, such as feed-water pumps and a small feed-water tank. Boiler feed water is obtained from condensate, the required make-up water being taken from the water well.

Electric Power Generation

The electric power used in the plant is generated by a unit, situated in the auxiliary building, consisting of a 175-kw., 219-kva., 480-volt, 264-amp., 3-phase, 60-cycle generator driven by a 240-hp. Clark vertical gas engine having a rated speed of 514 revolutions per minute.

Construction

All buildings except that housing the office and laboratory are of steel frame construction covered with corrugated asbestos. The main compressor building is 28 ft. by 72 ft., and that housing the electric power generating plant 14 ft. by 35½ feet. Steel sash and steel doors are used and the windows are large and numerous, providing ample light and ventilation. Light fixtures are vapor- and fire-proof and wiring is carried in steel conduits.

A building of wooden construction is provided for the office personnel and plant superintendent's office and to house the laboratory. The company camp consists of five modern cottages.

The plant also is equipped with meters, pressure regulators, liquid level controllers and indicators, thermometers, pressure gauges, and other necessary control instruments.

For storage of finished gasoline there are four horizontal tanks having a total capacity of 67,000 gallons.

Gas Analysis

The gas is supplied by some 200 wells in the Benavides field. An analysis of a typical feed gas is as follows, and for purposes of comparison an analysis of the tail gas and stabilizer gas also is given. (Table 1)

These analyses are not averages but are representative. The feed-gas composition varies somewhat depending upon the temperature and pressure at the separators, particularly noticeable with respect to the gas produced during the day and at night because of the widely differing temperatures. The separators are operated at about atmospheric pressure. Some of the separators are elevated, oil flowing to stock tanks by gravity. From others the oil is boosted to storage tanks by a small blow-case operated by residue gas pressure. All wells are flowed continuously through chokes.

TABLE 1
Gas Analysis

Feed Gas:	
Methane	83.46
Ethane	5.69
Propane	4.62
Iso-butane	1.37
n-butane	1.57
Iso-pentane	1.13
n-pentane	.49
Hexanes plus	1.67
Tail Gas:	
Methane	86.12
Ethane	7.48
Propane	4.38
Iso-butane	.94
n-butane	1.08
Iso-pentane	0.00
n-pentane	0.00
Hexanes plus	0.00
Stabilizer Gas:	
Methane	26.95
Ethane	12.57
Propane	37.37
Iso-butane	14.73
n-butane	8.38
Iso-pentane	0.00
n-pentane	0.00
Hexanes plus	0.00

Plant Expansion

Construction work is now under way at the plant that will increase its

TABLE 2
Analysis of Stabilized Gasoline

Propane	0.00
Iso-butane	2.67
n-butane	19.17
Iso-pentane	18.80
n-pentane	13.27
Hexanes plus	46.09

Gravity, 77

90 deg. fahr.	Initial, %
96	5
100	10
110	20
120	30
132	40
144	50
160	60
180	70
196	80
221	90
305	95
305	E.P.
95.8	Rec.

18.4 lb. Reid vapor pressure

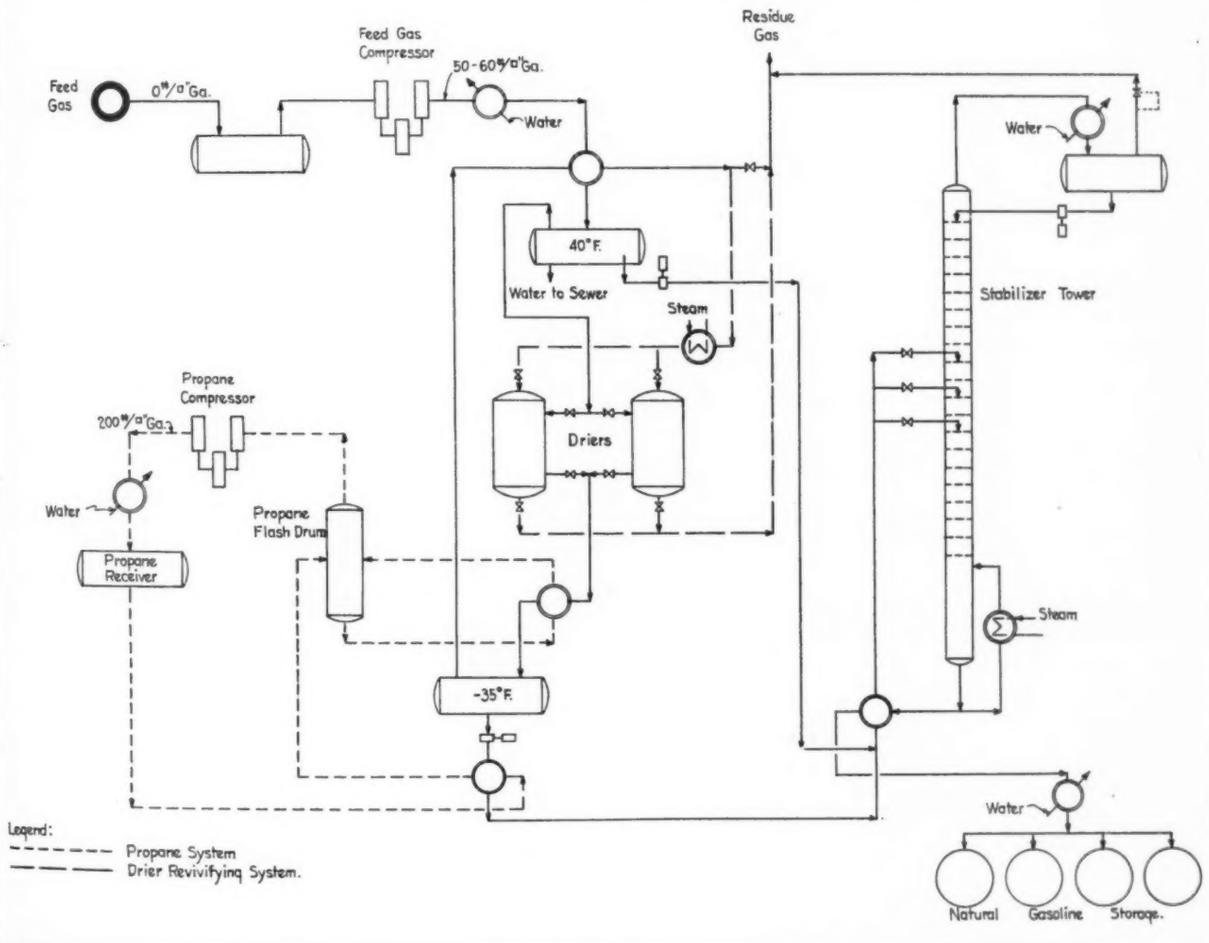
capacity by 2,225,000 cu. ft. of feed gas per day and 1,000,000 cu. ft. of propane gas. The expansion program includes the installation of one 500-hp. super-2-cycle, right-angle compressor unit, a set of three motor-driven water pumps, the addition of three bays to the cooling tower, the installation of another scrubber, and the extension of the main compressor building. The water pumps now in use will be converted to steam-driven units and employed as standbys. The new units will be driven by 100-hp. motors whereas 50-hp. motors are in use at present.

The plant was designed by the M. W. Kellogg Company, New York, New York, the general contractors, and all equipment, except the compressor units, was manufactured to their specifications. J. F. Pritchard and Company, Kansas City, Missouri, were sub-contractors on construction.

TABLE 3
Operating Data

Pressures:	
Feed Gas	
Plant inlet	Atmos.
Compressor discharge	50-60 lb. gauge
Residue Gas	40-50 lb. gauge
Propane	
Compressor suction	Atmos. to 6-in. vacuum
Compressor discharge	Approx. 200 lb.
Stabilizer	175 lb.
Steam	200 lb.
Temperatures:	
Feed Gas	
Entering driers	40 deg. fahr.
Final cooler outlet	minus 35 deg. fahr.
Gas for drier revivification	325-350 deg. fahr.
Residue gas from plant	75 deg. fahr.
Stabilizer	
Feed entering	160 deg. fahr.
Bottoms	230 deg. fahr.
Top	140 deg. fahr.
Reflux drum	100 deg. fahr.

Flow diagram for low-temperature gasoline recovery plant



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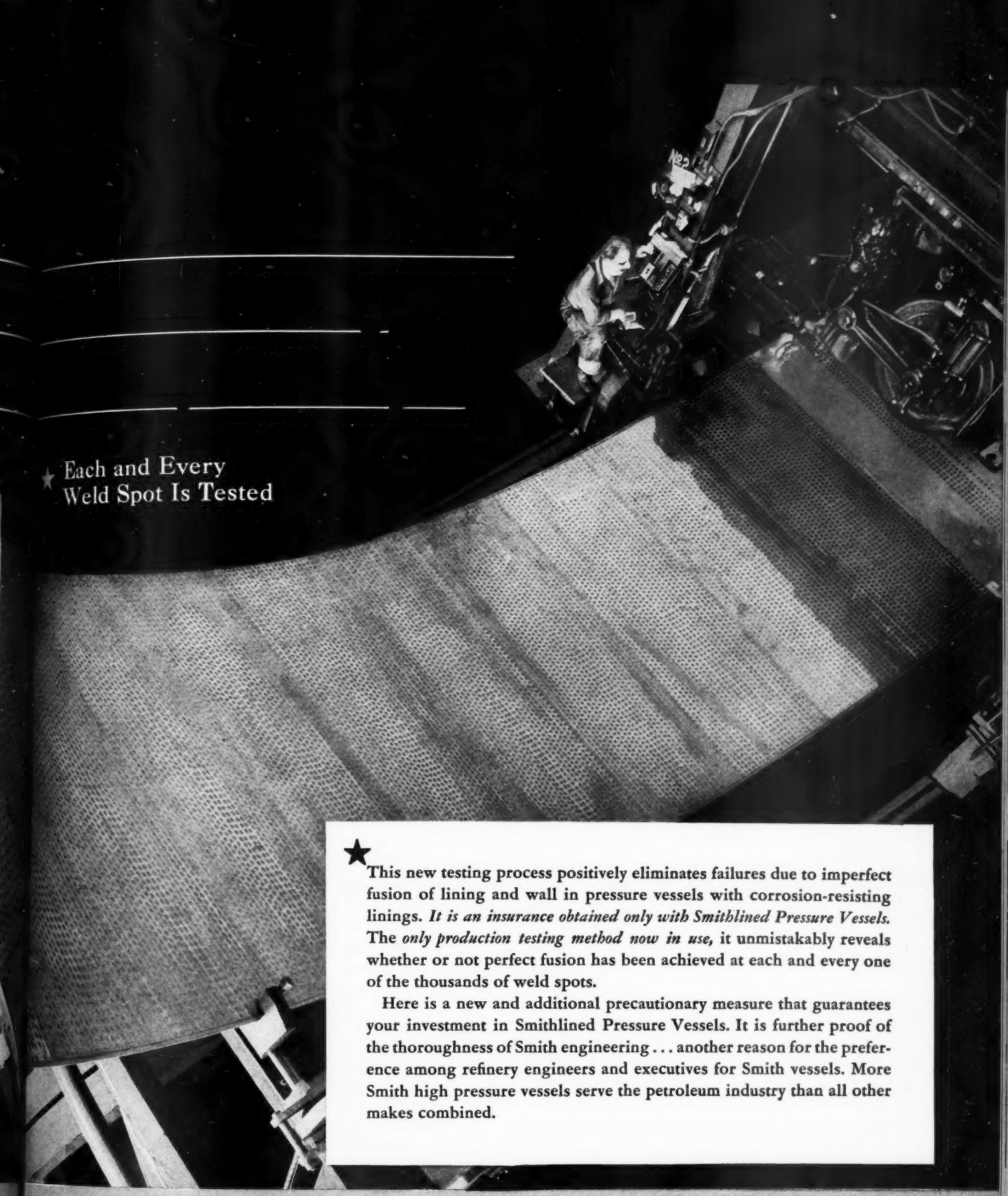

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The mud system at a California well and a mud-testing cabinet conveniently situated

By
WALLACE A. SAWDON
Petroleum Engineer,
Los Angeles

Refined Testing Methods at Well Improve Mud Control

Accuracy and reliability of tests made with portable equipment approach those of laboratory examinations

THE proper conditioning of drilling mud has been an important factor in the successful completion of the deep wells drilled in California. Much has been learned about the characteristics of mud fluid during the last few years and laboratory study has been the means of recognizing that greater efficiencies may be obtained by preparing a mud of definite properties to meet specific conditions. Of particular importance, however, is the fact that companies have not only recognized the necessity for proper mud conditioning but have provided the field personnel with equipment for making intelligent mud tests that can be utilized for maintaining good mud and for immediate correction of deficiencies caused by changes in well conditions.

Mud weight has, of course, long been given important consideration. It is just as important as ever where high pressures must be overcome or caving or heaving formations must be held in place. Excessive weight and the promiscuous dumping of weight materials into the mud, however, are no longer the vogue in controlled drilling fluid, and those other characteristics that influence the effectiveness of the weight and give the mud fluid the other necessary properties it must contain are now being given due attention.

The native clays in California vary widely in many of their characteristics and, although weight material must always be added to give mud mixed from the clays the required weight for specific conditions, the treatment of the fluid to provide the other necessary properties must be governed by tests made on the mud fluid in use. The long haul of mud to distant fields where local clays or shales make poor drilling fluid is no longer practiced to the extent that it was several years ago, as it has been found that the use of water with admixtures that can be controlled to give the most efficient fluid is often not only less expensive but more satisfactory.

The economics of mud mixing naturally enters into the selection of the mud to use. This not only takes into consideration the first cost of the drilling fluid but also the performance of the fluid and its influence on drilling time, wear on equipment, number of fishing jobs, protection of the sand, and condition of the hole. A somewhat greater first cost of mud fluid often is more than offset by considerable saving in time and money, which has in some wells become evident by comparison with performance in adjacent wells.

The maintenance of quality of the fluid is equally important, however, and many companies determine the actual condition of the mud periodically by reliable tests made at the well. This is true for virtually all the deep wells being drilled in California and for numerous shallow wells being drilled both by the major companies and by small operating companies. The original drilling fluid ranges from native mud (weight material being added if and when needed) to a mud made by mixing water with prepared bentonite and weight material to prepare a fluid that will meet definite specifications.

In the deep fields of Rio Bravo and Wasco, native mud is used for drilling the upper formations. The mud added by making hole is asserted to include sufficient colloidal material to provide adequate wall cake that is not too thick. For the deeper formations, however, the drilling fluid used by most companies is made of water mixed with prepared bentonite and weight material. The weight of this fluid at Rio Bravo will probably average about 78 lb. per cu. ft., the different companies following their own specifications. By interpolating on the accompanying graph this mud will be found to exert a hydrostatic pressure at 11,000 ft. of approximately 6000 lb. per sq. in., which is adequate to counterbalance the pressure encountered. At Wasco the density of the fluid used for the deeper drilling is maintained at approximately 82 lb. per cu. ft., and at 13,000 ft.

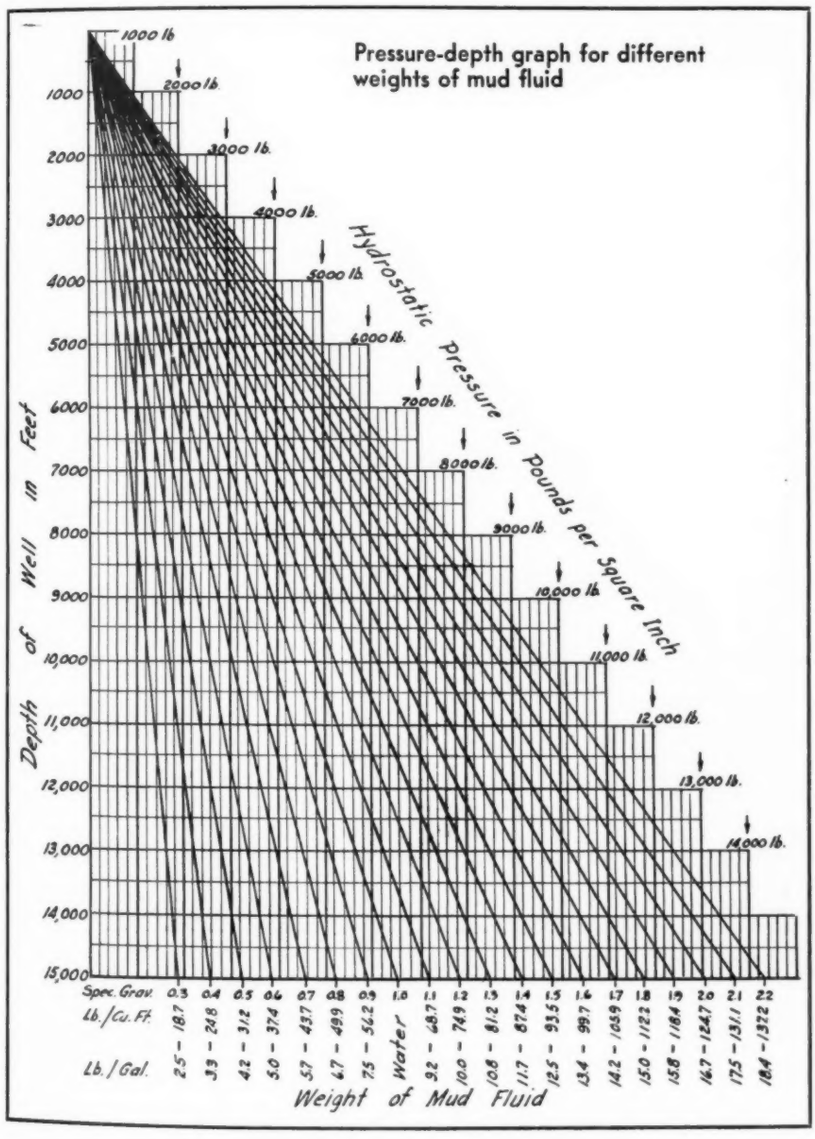
the mud exerts a hydrostatic pressure exceeding 8000 lb. per sq. inch.

The wall-building quality of the mud is as important at great depth where high pressure production is encountered as it is at shallow depth where low-pressure zones must be protected by the mud sheath formed on the face of the sand. The thinnest, most rapidly formed sheath of mud is the most desirable under any condition. The advantage of the thin cake lies not only in its thinness, which offers less obstruction in the hole, but also in the fact that almost always a thin cake is indicative of minimum filtration of water into the formation. From experiments reported by P. H. Jones[1] muds permitting the loss of large quantities of water deposit tough, thick mud cakes, whereas those preventing the loss of much water deposit thin, gelatinous cakes.

[1] "Field Control of Drilling Mud", by P. H. Jones, A.P.I. Drilling and Production Practice, 1937.

The effect of temperature on the wall-building qualities and the loss of water is especially important in the deep wells, where high temperatures must always be expected. Although the cake thickness increases to some extent at high temperature, the total water loss and rate of water loss show an increase that accelerates sharply in muds that are not strong in thixotropic properties. This was shown graphically by the result of tests conducted by P. H. Jones and E. C. Babson[2], which demonstrated clearly not only the difference in loss of water between muds strong and weak in thixotropic properties at low temperature but also disclosed that strong thixotropic muds lose water at a rate that increases slowly with increasing temperatures, in contrast to loss increases of 200 to 300 percent with a rise of temperature from 100 deg. to 260 deg. fahr. for weakly or moderately thixotropic muds.

[2] "Evaluation of Rotary Drilling Muds", by P. H. Jones and E. C. Babson, A.P.I. Drilling and Production Practice, 1936.



The weight of the mud and its cake-forming properties are naturally of importance in restraining caving formation. It is thought by some engineers that the speed with which the wells at Rio Bravo are being drilled has definitely aided in keeping in shape the great amount of open hole drilled, a distance that in some wells approaches 10,000 feet. Given proper wall-building characteristics, the mud fluid will form a thin cake in a short time and exclude most of the drilling water from the formation.

Mud is being chemically treated to an ever-increasing extent in California, mainly, however, by the major companies, which have spent a great deal of time in research and experiment. Some excellent results have been obtained but very few data can be released at the present time. Chemicals for thinning the mud by reduction of viscosity are, of course, in extensive use and have become definite factors in mud control. Here particularly each well becomes an individual problem. The chemicals must be introduced with definite knowledge of the characteristics of the mud and the formation being drilled.

A special material for treating mud used in drilling cement has recently been developed. The results obtained using this material were described in a previous article[3]. One engineer, who had used the material in a field where native mud and only a small amount of colloidal and weight material is used, pointed out that even though the cost of the new admixture was nearly as great as the cost of replacing the fluid after drilling the cement, it was thought to be advantageous to use it. Where a considerable amount of colloidal material or weight material or both is being used in the drilling fluid, the application of this material is believed to be economical as well as more satisfactory.

Vibrating screens for the removal of

[3] "Special Material Used to Treat Mud Used for Drilling Through Cement." *The Petroleum Engineer*, August, 1938.

sand and other solids have come into general use and at most of the deep wells two vibrating or shaker screens are employed. It has been found that gas-cut mud is greatly improved by the action of the vibrating screen, although it is obvious that all gas cannot be released by passing the fluid through the screen. The mere addition of weight material to increase the weight of gas-cut fluid is no longer practiced, as experience has demonstrated that this procedure frequently results in worse cutting as the content of weight material is increased. By proper testing, the actual condition of the mud is determined and remedial measures can then be taken.

Field Testing Equipment

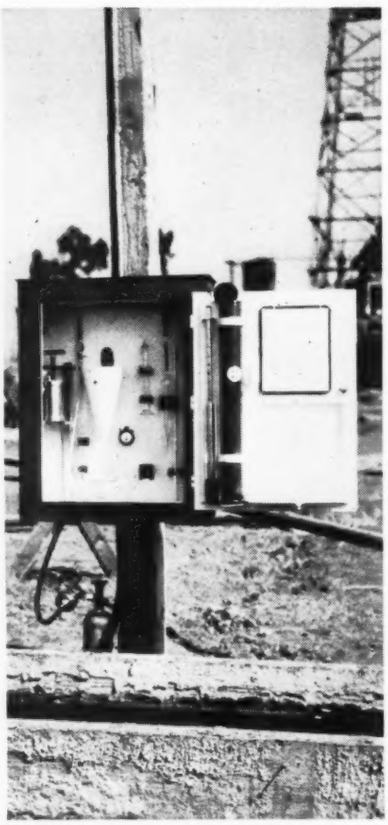
Several of the major companies in California have designed cabinets for field testing equipment, which are set up at each drilling well. In discussing equipment for field testing, P. H. Jones[1] indicates that organizations required for field control of drilling mud fall into two categories. "The first involves the control of mud in individual wells located far from other drilling projects and established laboratory facilities, and the second has to do with control where a number of wells are being drilled in the same field or in fields sufficiently close together to permit the establishment of a single field laboratory for making field tests."

A completely equipped cabinet, which virtually provides a small laboratory at the well, is used extensively in California. It is placed convenient to the mud ditch and, although it naturally does not supplant a central laboratory where more exhaustive tests and research work must be conducted, it offers a means of maintaining close control of the drilling fluid.

The cabinet as illustrated is equipped with air and water connections and an electric light. Samples of mud to be tested are taken from the mud stream and placed in a bucket hung on the bottom of the cabinet.

For viscosity determination a Marsh funnel and stop watch are provided. This funnel is constructed so that either the 500-cc-In-and-Out method or the 1500-cc-In-and-1000-cc-Out method can be employed. The operator can use the funnel for indication of gel strength by refilling it and making another run after five minutes.

In determining the need for chemical treatment of drilling mud to reduce the viscosity, the viscosity of the sample is first measured. To 500 cc of the mud 5 cc of treating chemical is added and the mixture agitated thoroughly. The consistency is again determined and compared with the initial reading. Tests may then be continued until the most efficient chemical proportion for viscosity reduction is found.



A cabinet that is actually a small mud-testing laboratory is set by the mud ditch

A Braun "mudwate" hydrometer is used for measuring the weight of the fluid. A container fastened on the door of the cabinet is provided for holding the water in which the hydrometer is used. The stem is graduated in lb. per cu. ft., lb. per gal., specific gravity, and lb. per sq. in. per 100 ft. of depth.

For measuring the sand content by a special elutriation tube, a tank is built into the top of the cabinet and a water inlet and overflow pipe maintain a constant head. Seventy-five cc of mud is placed in the tube, diluted with water to 250 cc and shaken thoroughly. Water is first admitted into the tube very slowly by cracking the valve in order to make sure that none of the sand is washed away. The sample is flushed out until all the mud is washed away and the sand then is allowed to settle to the bottom. After tapping the tube to compact the sand, the percent by volume of sand is read directly. The large sample used gives a greater degree of accuracy.

A stopper graduate is provided for making settling tests. In this test the appearance of any clear water at the surface will indicate the flocculation or deflocculation of the mud or will show deficiency of colloidal content. By employing the dilution method an accurate estimate of flocculation, deflocculation, and colloidal content can be made. In doing this 10 cc of mud is added to 900 cc of water and this is thoroughly shaken to mix. It is then let settle for a period of time, usually one hour. A negative test shows either flocculation or a lack of colloids. If the suspended material is coagulated it indicates flocculation. Sometimes a deflocculating agent or mud thinner is added to disperse colloidal material in suspension.

Wall-building property is measured by a filter press set in the left side of the cabinet. The mud is placed in a vertical cylinder at the bottom of which is a filter paper, a wire mesh, and a base cap provided with filtrate outlet. Below this a graduate is set to catch the water filtered out and measure the water loss. The cake is formed in the cylinder and is readily removed and measured upon completion of the test.

This is a pneumatic tester and the pressure is exerted by compressed air. Air is supplied by a cylinder set below the cabinet. If necessary, water can be used if the pressure is constant. Many companies have compressed air available and this provides a better source of supply, as it can be regulated to the desired pressure. In other installations a large tank of compressed air or nitrogen is placed near the cabinet and this larger cylinder is better than the small one attached to the standard.

The filter presses now being used are limited to pressures of 100 lb. per sq. in. but one is being developed for cabinet installation that will provide pressures to 1000 pounds. Moreover, a temperature control is being designed that will permit the formation of a mud cake at any constant temperature below 200 or 300 degrees. The importance of temperature in measurements of cake building and water loss has been indicated and when equipment provided with temperature control is available, field testing will approach more closely to laboratory analysis.

Routine testing by many companies consists of hourly measurement of viscosity, weight, and sand content. Filter press tests are generally made once a day but under many conditions are made less frequently. When equipment is always available to provide intelligent data on the mud condition, however, the mud can be controlled despite all changes that take place while drilling. The appearance and feel of mud is frequently deceptive and it is now recognized that to obtain proper control actual tests must be made regularly.

Alaskan Well Has Oil Showing

Test six miles from Illiamna Bay, before being closed-in for the winter, indicated possibility of oil production in northern country—another test being drilled.

By WALLACE A. SAWDON
Petroleum Engineer, Los Angeles

THE Iniskin Drilling Company's well in Alaska was tested recently, before operations were suspended for the winter, and the showings of oil and gas and the pressure built-up when the well was closed-in indicates that the possibilities for production are good. This is the only well in Alaska drilling in or near a prospective oil zone at the present time, but a joint test of Standard Oil Company of California, Union Oil Company, and Tide Water-Associated Oil Company has been started and was last reported drilling at a depth exceeding 1000 feet.

The Iniskin well is situated six miles from Illiamna Bay, which is on the western side of Cook Inlet. The location with reference to Anchorage, Seward, and the joint test is shown on the accompanying map. Before operations were suspended for the winter the hole was drilled to a depth of 7156 feet. Surface pipe was cemented at a depth of approximately 340 ft. and a string of 9-in. casing at 4250 feet. A combination string was run to bottom, 6-in. pipe extending to the shoe of the 9-in. casing and 5¾-in. from there to bottom. The 5¾-in. was perforated below 5600 feet.

The well was swabbed to 3500 ft. and bailed to 2150 ft. from bottom. Although high pressures were evident the well did not kick-in. The operators now plan to move-in more equipment, as there is not sufficient tubing or other needed material on hand to tube and produce the well if it should be productive. Latest reports received indicate that after the well is closed-in pressure builds-up and must be relieved. The well probably will be drilled deeper, as the deeper formations are believed to offer better prospects. The gravity of the oil is 50 deg. A.P.I.

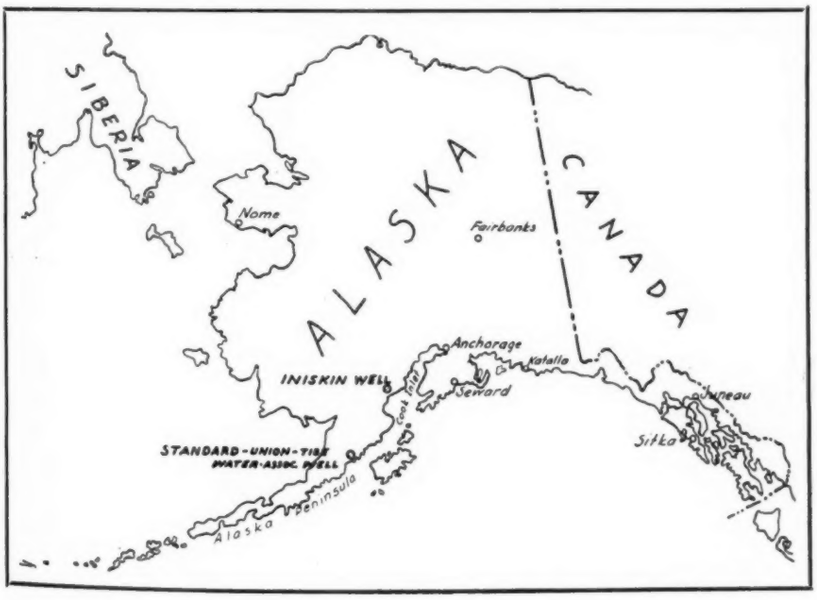
Heavy-duty equipment of standard type is being used and is all steam-driven except the mud pumps, which are driven by Diesel engines. The use of Diesel engines to drive the pumps aids in conservation of the fuel oil supply, which is difficult to maintain, as it must be brought from the United States in drums. The formations drilled are hard and rock bits have been used for all drilling. Density of the fluid used for drilling at lower depths has been maintained at 104 lb. per cu. ft., and both colloidal admixture and weight material are added to the fluid. The mud is thinned by addition of chemical.

The Iniskin Drilling Company well near Anchorage, Alaska

Great difficulties are experienced in moving equipment to the well. Ships must anchor six miles off-shore and everything is brought from the ships to the company's pier by barge or lighter. It is hauled another six miles to the well location. Transportation of equipment is therefore slow and costly.

Drilling began in the spring of 1936 and was continued to the middle of October of that year and from April to October, 1937. This year drilling was suspended earlier than usual because the equipment necessary for making a thorough test of the well or for drilling deeper was not available. There is a maximum tide of 32 ft. at the pier. Minimum temperature is zero but the slush and ice hamper operations. Short-wave communication with Anchorage is maintained and plane service from that point can be obtained when needed.

The joint test of Standard-Union-Associated has been drilled to a depth exceeding 1000 ft. and the officials



Map showing location of the Iniskin well, and the Standard-Union-Tide Water-Associated test

Small equipment, materials and supplies are carried ashore in a launch

plan to continue operations through the winter. This well is also inland but ships can come close to shore in Jute Bay, which is just south of Cold Bay on the southeast side of Alaska Peninsula. This is in the Kanatak district and the well itself is only a few miles northeast of the town of Kanatak.

At Katalla on the south coast of Alaska there was once a shallow field. The depth of the wells was approximately 1000 feet. No oil has been produced for several years but considerable acreage between Katalla and Cordova to the west has possibilities for oil and may be tested within the next year or two.

Petroleum From K.M.A. Pool Analyzed

CRUDE oil from the deep K. M. A. producing zone (Strawn formation) in Wichita and Archer counties, Texas, is an intermediate base oil having a gravity of 43.8 deg. A.P.I. and a sulphur content of 0.21 percent, according to an analysis made by the U. S. Bureau of Mines, on a sample obtained from the Kadane et al Mangold No. 1-A well, completed in November, 1937, at a total depth of 3752 ft., in formation found at 3689 feet.

The distillation summary of the oil includes 40.8 percent gasoline and naphtha, 10.7 percent kerosene distillate, 13.4 percent gas oil, according to the Bureau of Mines method of calculation.

A second sample of crude oil for comparison was taken from the Blackwell-Helmerich and Payne (formerly Hull and Silk), Wilson No. 1 well, a discovery well in the Panther area, approximately 13 miles southeast of the Kadane Mangold well. This sample is representative of the first oil produced in the area, from a well the total depth of which is 3860 feet. The distillation summary includes 41.0 percent gasoline and naphtha, 10.3 percent kerosene distillate, 13.7 percent gas oil and heavier distillates. Inasmuch as the analysis of this sample indicated little difference in oil from the two wells, only the analysis of the oil from the Kadane-Mangold well is given.

Although deep production in the K. M.A. area was first reported in April, 1931, when the Deep Oil Development Company completed the Munger 1-A well and ten additional wells, it was not until April, 1937, when the Petroleum Producers Company completed well 73 on the Munger tract, that the deep drilling boom started, resulting quickly in outlining a large and important reserve of high gravity oil.

K. M. A. Field

Mangold Well No. 1-A—3752 ft. sand and limestone — Texas
Kadane, Inc. — Wichita County

GENERAL CHARACTERISTICS

Specific gravity, 0.807 — A.P.I. gravity, 43.8 deg.
Sulphur percent, 0.21 — Color, brownish green
Saybolt Universal viscosity at 77 deg. fahr., 36 sec.
Saybolt Universal viscosity at 100 deg. fahr., 35 sec.

DISTILLATION, BUREAU OF MINES HEMPEL METHOD

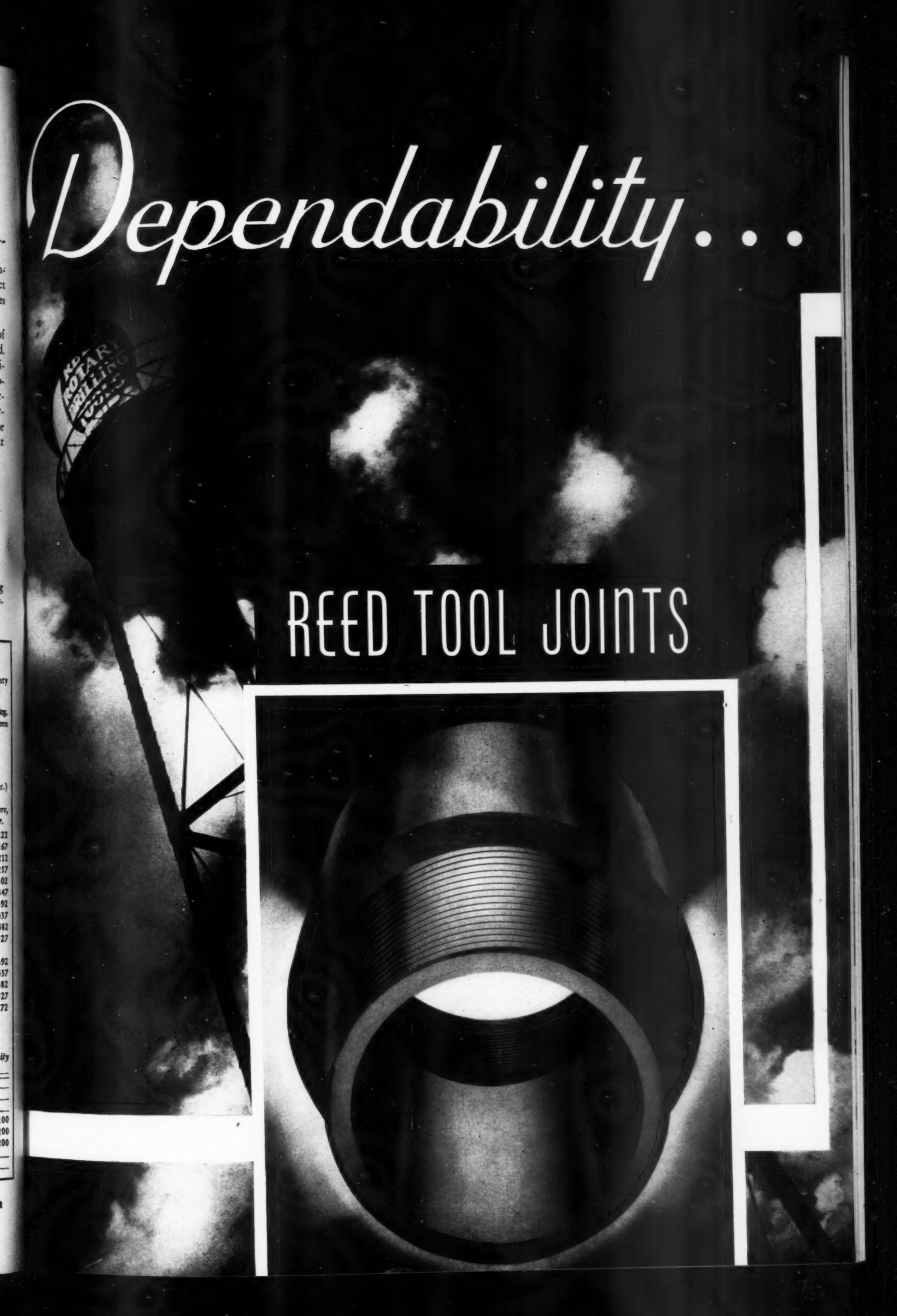
Dry distillation — Barometer 741 mm. — First drop: 30 deg. cent. (86 deg. fahr.)

Temperature, deg. cent.	*Percent cut*	*Sum, percent*	*Specific gravity of cut*	*Deg. A.P.I. of cut*	*Viscosity at 100 deg. fahr.*	*Cloud test, deg. fahr.*	*Temperature, deg. fahr.*
Up to 50	4.0	4.0	0.641	89.3	.....	.....	Up to 122
50— 75	4.2	8.2	.661	82.6	.....	.....	122—167
75—100	7.4	15.6	.708	68.4	.....	.....	167—212
100—125	7.5	23.1	.736	60.8	.....	.....	212—257
125—150	6.9	30.0	.756	55.7	.....	.....	257—302
150—175	5.8	35.8	.776	50.9	.....	.....	302—347
175—200	5.0	40.8	.791	47.4	.....	.....	347—392
200—225	5.2	46.0	.805	44.3	.....	.....	392—437
225—250	5.5	51.5	.820	41.1	.....	.....	437—482
250—275	5.5	57.0	.838	37.4	.....	.....	482—527
Vacuum distillation at 40 mm.							
Up to 200	3.6	3.6	0.852	34.6	41	10	Up to 392
200—225	5.9	9.5	.859	33.2	47	30	392—437
225—250	4.8	14.3	.874	30.4	60	50	437—482
250—275	3.8	18.1	.882	28.9	89	65	482—527
275—300	4.8	22.9	.892	27.1	160	80	527—572

Carbon residue of residuum 6.7 percent; carbon residue of crude 1.1 percent.

APPROXIMATE SUMMARY

	Percent	*Sp. gr.*	*Deg. A.P.I.*	*Viscosity*
Light gasoline	15.6	0.678	77.2	———
Total gasoline and naphtha	40.8	0.730	62.3	———
Kerosene distillate	10.7	.813	42.6	———
Gas oil	13.4	.849	35.2	———
Nonviscous lubricating distillate	9.0	.863-.884	32.5-28.6	50-100
Medium lubricating distillate	6.0	.884-.898	28.6-26.1	100-200
Viscous lubricating distillate	———	———	———	Above 200
Residuum	15.8	.946	18.1	———
Distillation loss	4.3	———	———	———


Dependability...
REED TOOL JOINTS

Abstracts of Papers Presented at Meeting Division of Petroleum Chemistry, American Chemical Society, Milwaukee, September 5th to 9th, 1938

Ethyl Fluid Blending Chart for Motor Method Octane Numbers

L. E. HEBL, T. B. RENDEL, and F. L. GARTON, Shell Petroleum Corporation
Engine Research Laboratory, Wood River, Illinois

A CHART has been constructed such that a linear interpolation is obtained between A.S.T.M.-C.F.R. motor method octane numbers and tetraethyl lead concentrations in any base gasoline. This chart allows the "lead susceptibility" of a gasoline to be expressed as a single figure.

Some Factors Affecting the Knock Rating and Lead Susceptibility of Gasolines

FRANCIS G. GRAVES, Standard Oil Company of California

PREVIOUS literature on the subject, dealing particularly with the loss of knock rating during acid treatment of cracked gasolines and the influence of composition and sulphur content of gasolines on their lead susceptibility, is reviewed and summarized. Some earlier investigations have furnished a general indication that the loss of knock rating of cracked gasolines during acid treatment was dependent on their nature and source. This paper presents a definite relation between octane number loss for cracked gasolines and their initial knock rating, the latter being dependent in turn on cracking stock origin. Also, composition and sulphur content of gasolines have been recognized as having a direct bearing on their lead susceptibility. Making use of a numerical expression for lead susceptibility developed by other investigators, relations between this characteristic and sulphur content are developed for straight-run and cracked gasolines and aromatic stocks. This relation should prove useful in estimating the lead susceptibility of various gasoline stocks. Paraffin and naphthene hydrocarbons have the highest susceptibility. Although pure aromatic compounds have a higher lead susceptibility than olefins, they are more sensitive to the effect of sulphur compounds.

The Tetraethyl Lead Susceptibility of Gasolines Treated with Doctor Solution versus Caustic Washing

L. M. HENDERSON, W. B. ROSS, and C. M. RIDGWAY, Pure Oil Company

MERCAPTANS present in gasoline stocks may be removed to a very large extent by efficient scrubbing with caustic soda solutions. Data are presented to show that gasolines thus treated require less tetraethyl lead for the production of a given octane number or antiknock value than the same gasoline stock treated in the conventional way with sodium plumbite (Doctor Solution) and elemental sulphur. The difference in tetraethyl lead requirement is greater when an excess quantity of sulphur is used in the conventional plumbite treatment. Efficient scrubbing of mercaptan-containing gasoline with NaOH solutions followed by the sodium plumbite treatment provides better tetraethyl lead susceptibility than does treatment of the same gasoline stock with plumbite solution and sulphur only. The spent caustic solutions may be regenerated by boiling and used repeatedly.

Studies in Doctor Sweetening. II. Regeneration of Doctor Solutions

CHARLES WIRTH, III, C. D. LOWRY, Jr., and J. R. STRONG

THE importance of satisfactory regeneration of doctor solution for proper economy is emphasized. The many factors contributing to difficulties in the conversion of lead sulphide to litharge by the usual refinery methods are each discussed. A description of several methods of regeneration in use is given.

Some data are presented showing the advantages of a turbulence column, particularly for use by the small refiner. A description of a doctor plant incorporating a satisfactory recovery and regeneration system is given.

The Production of High-Octane Isoparaffinic Fuels by the Addition of Olefins to Isoparaffins

S. F. BIRCH, A. E. DUNSTAN, F. A. FIDLER, F. B. PIM, and T. TAIT, Anglo-Iranian Oil Company, Ltd., Sunbury-on-Thames, Middlesex, England

IN the presence of concentrated sulphuric acid the lower olefins, with the exception of ethylene, react with isobutane to give a product from which a fully saturated fraction b.p. 27 deg. to 185 deg. cent. may be isolated by distillation. This material apparently consists entirely of isoparaffins ranging from isopentane to isodecanes and higher. Its high octane rating, roughly 90+, coupled with its low sulphur content, renders it an excellent component for 100-octane aviation gasoline. The reaction is not limited to isobutane and has been extended to isopentane and 2-methylpentane, but the lower octane ratings of the gasoline fractions obtained from these isoparaffins render them less suitable as components for 100-octane fuels. The effect of varying the reaction conditions upon the yield and nature of the product is outlined. As satisfactory starting materials for commercial operation the unsaturated C_4 cut obtained from normal cracking operations may be employed together with an isobutane concentrate taken from natural gasoline stabilization. The heat evolved in the reaction and acid consumption are briefly discussed.

The Thermal Decomposition of Petroleum Hydrocarbons into Free Radicals

B. L. EVERING, Standard Oil Company (Indiana), Whiting, Indiana

VARIOUS close-cut naphthas and petroleum butane were heated to temperature near 1000 deg. cent. at low pressures. The presence of free radicals in the decomposing hydrocarbons was demonstrated by contacting the vapors with a fresh lead surface (constantly renewed by condensation from vaporized lead), and analyzing the products for lead alkyls. The effect diminishes very rapidly as the pressure is increased above 6 mm. of mercury. The data obtained do not permit any confident statements as to the mechanism involved.

Chemical Reactions of Cracked Residues

HANS TROPSCH, CHARLES L. THOMAS, J. C. MORRELL, and GUSTAV EGLOFF

THE oil remaining after the removal of asphaltines from cracked residue will react with nitric, sulphuric, and phosphoric acids, chlorine, sulphuryl chloride, anhydrous aluminum chloride, stannic chloride, titanium tetra-chloride, ethyl sulphate, and potassium permanganate.

Sulphuric acid treatment raises the viscosity index of the oil. The viscosity of the treated oil can be raised by chlorinating the oil and treating the chlorinated product with anhydrous aluminum chloride and benzene. The optimum amount of chlorine is about ten percent of the oil. The oils so formed have pour points of 80 to 90 deg. fahr. due primarily to wax in the original residue.

Bauxite as an Adsorbent for Pennsylvania Oils

OGDEN FITZSIMONS, R. G. CAPELL, and G. C. JONES

ACTIVATED bauxite and Fuller's earth are compared, when used to produce Pennsylvania neutrals and bright stocks by percolation. Bauxite will stand higher burning temperatures than Fuller's earth but prolonged overburning is harmful, as the time element, heretofore neglected, is a variable. Bauxite is very sensitive to such variables as percolation rate and mesh, and hence requires unusual care in laboratory evaluations.

No reliable means of evaluating a bauxite as an adsorbent from chemical analysis figures has been found. An apparatus and procedure are described for evaluating adsorbents by percolation wherein temperatures are maintained by circulating organic vapors through double-walled filters.

The Effect of Pressure on Viscosity in Relation to Lubrication

J. W. GIVENS

AN analysis has been made of data on the temperature rises in three oils while lubricating a partial bearing at high loadings. Using the pressure coefficients of viscosity of these oils, an operating variable was calculated that accounted for the observed temperature rises and that should be useful in studying lubrication. Differences in the frictional characteristics of these oils that might be ascribed to oiliness could be accounted for by known properties of the oils. The use of the term "oiliness" to account for such differences admits ignorance of the properties of liquids and the need for this term will disappear proportionately as more exact information becomes available.

Chloro-Organic Compounds in Relation to Cracking Coil Corrosion

R. H. GARDNER, JOHN W. TETER, and L. I. HANSEN, Sinclair Refining Company

Chloro-Organic Compounds From Salts

GAS oil heater coils evinced corrosion when gas oil from a high-salt Mid-Continent crude was cracked. Traces of chlorine compounds were found in the commercial gas oil heater feed. The immediate problem was to confirm the formation of chloro-hydrocarbons in the crude heat exchange and flashing steps, as such compounds would subsequently decompose at cracking temperatures to give HCl.

As $MgCl_2$ was believed to be the main source of active chlorine a M-C crude and several fractions were digested with $MgCl_2$ and water under conditions comparable to crude heat exchange and flashing operations. Digested samples, after careful washing and drying, contained chlorine in the order of 0.0007 to 0.002 percent. Therefore, chlorination of certain oil molecules can occur by reaction of $MgCl_2$.

Chloro-Organic Compounds From CCl_4

The question has been raised concerning the effects on refinery operations should CCl_4 be used in cleaning out oil wells.

Crude oil was heated with CCl_4 and moisture under conditions of crude heat exchange (350 deg. fahr.). HCl was evolved copiously. Organic chlorine was found in the household heating oil, gas oil, and residuum fractions in the order of about 0.12 percent. Therefore, chloro-compounds are produced.

In commercial operation whatever CCl_4 did not decompose in crude heat exchange before the primary flash would be found in the straight-run gasoline. Regular gasoline blends with CCl_4 showed no significant changes in oxidation susceptibility and antioxidant efficiencies. However, octane and TEL susceptibilities were seriously lowered.

Organic Sulphides. Specific Gravities and Refractive Indices

GEORGE W. AYERS, Jr., and M. S. AGRUSS, The Pure Oil Company, Chicago, Illinois

A NUMBER of organic sulphides were prepared (except ethyl and *n*-butyl) by adding the corresponding bromides to sodium sulphide in alcohol, and were purified by fractionation. Ethyl and *n*-butyl sulphides were purchased and refractionated.

Sulphide	Boiling Range (corr.) Deg. cent.	Pressure mm.	$d\frac{0°C.}{4°C.}$	$d\frac{20°C.}{4°C.}$	$d\frac{25°C.}{4°C.}$	$n\frac{20°C.}{D}$	$n\frac{25°C.}{D}$
Ethyl	91.2- 91.5	746	0.8524	0.8331	0.8299	1.4428	1.4395
n-Propyl	141.6-142.1	749	0.8525	0.8358	0.8319	1.4481	1.4456
Isopropyl	118.7-118.9	749	0.8306	0.8136	0.8092	1.4381	1.4354
n-Butyl	186.4-187.0	750	0.8535	0.8386	0.8348	1.4529	1.4504
Isobutyl	168.2-168.8	749	0.8427	0.8262	0.8232	1.4463	1.4439
n-Amyl	227.1-227.5	754	0.8532	0.8390	0.8350	1.4556	1.4532
Isoamyl	214.3-214.8	754	0.8476	0.8323	0.8284	1.4520	1.4499

Surface Tension of the Hydrocarbons

DONALD L. KATZ and WILLIAM SALTMAN, University of Michigan

DATA on the surface tension of ethane, propane, and *n*-butane under their vapor pressures from 0 to 40 deg. cent. are reported. These data and those of the literature have been correlated to give surface tensions for normal paraffins, ethane through octane from 0 deg. cent. to the critical temperature. The presentation of a surface tension—reduced temperature plot and a discussion of the possibility of using surface tension measurements as criteria for critical temperatures of petroleum hydrocarbons are included.

The Vapor Pressures of the CIS and TRANS Isomers of Decahydronaphthalene

W. F. SEYER and HERMAN NEMETZ

THE static method was used for determining the vapor pressures of these isomers. Regular vapor pressure curves were obtained when the pressure was plotted against the temperature. Plotting log pressure against the reciprocal of the absolute temperature gave a straight line for the *cis* isomer and two straight lines for the *trans*. This indicates two forms for the *trans* isomer, and thus these results favor the existence of more than two isomers for the hydrocarbon, decahydronaphthalene.

Systematic Distillation of a Dewaxed Lubricant Fraction of a Mid-Continent Petroleum Preliminary to Isolating its Constituents. A Continuous High-Vacuum Still and Apparatus for Determining Boiling Points at Low Pressure

R. T. LESLIE and W. W. HEUER, National Bureau of Standards

A SAMPLE of lubricant stock having about the properties of 20 W lubricating oil was obtained from a refinery supplied with crude oil from the Oklahoma City field. Two hundred and forty gallons were distilled through a semi-commercial vacuum still. A continuous high-vacuum laboratory still and an apparatus for determining boiling points were constructed. The material was distilled systematically three times. After the third distillation, there remained 762 kg. of material which distilled between 135 deg. cent. and 270 deg. cent./1 mm. Hg. There appear four large concentrations in volume. The results of the distillation of the lubricant fraction and of the naphtha fraction from a Ponca City petroleum are compared at the same stages.

Exhaustive Fractionation, by Distillation and Extraction, of the "Extract" Portion of the Lubricant Fraction From a Mid-Continent Petroleum

BEVERIDGE J. MAIR and CHARLES B. WILLINGHAM

THIS paper describes the separation, by distillation and extraction, of the "extract" portion of the lubricant fraction from a Mid-Continent petroleum. After a preliminary separation of the "asphaltic" material, the remainder of the sulphur dioxide-soluble material and the silica gel "hold-up" were combined and systematically distilled until substantially constant-boiling fractions were obtained. Five charges of these fractions with narrow-boiling ranges were then prepared and each charge of 500 to 700 grams was separated into 30 to 40 fractions by reflux extraction with methyl cyanide, or methyl cyanide containing acetone, in 16.7-m. columns. Kinematic viscosities at 100 deg. fahr. and 210 deg. fahr., refractive indices, densities, refractive dispersions, specific optical rotations, and aniline points were determined for most of the fractions from the extraction process. In addition for 41 "key" fractions there are reported boiling points, molecular weights, and carbon-hydrogen ratios, and for some of these fractions there are given the percentages of sulphur, nitrogen, and oxygen. Attention is called to a number of interesting facts in connection with the properties of these petroleum fractions.

The Hydrogenation of Fractions Prepared by Extensive Separation of the "Extract" Portion of the Lubrication Fraction from a Mid-Continent Petroleum

BEVERIDGE J. MAIR, CHARLES B. WILLINGHAM, and ANTON J. STREIFF

TO obtain information about the chemical constitution of the "extract" portion of the lubricant fraction from a Mid-Continent petroleum, 15 selected fractions, prepared by extensive distillation and extraction, were completely hydrogenated. The hydrogenation procedure is described and there are tabulated and compared values for the physical constants of the fractions before and after hydrogenation. Evidence is presented to show that, under the conditions of these experiments, namely, temperatures from 230 deg. cent. to 250 deg. cent. and pressures of hydrogen from 170 to 210 atmospheres, the fractions were completely hydrogenated and that no breakdown of the molecules occurred.

The Chemical Constitution and Physical Properties of the "Extract" Portion of the Lubricant Fraction from a Mid-Continent Petroleum

BEVERIDGE J. MAIR, CHARLES B. WILLINGHAM, and ANTON J. STREIFF

A CORRELATION has been made of the properties of 179 fractions of oil prepared by extensive distillation and extraction of the "extract" portion of the lubricant fraction from a Mid-Continent petroleum. The correlation includes a comparison of the properties of these fractions with those of a selected 15 of the same fractions after complete hydrogenation, with those of synthetic hydrocarbons of high molecular weight, and with those of fractions of water-white oil previously prepared from this same lubricant fraction.

The following physical and chemical properties have been compared: specific optical dispersion, specific optical refraction, specific optical rotation, aniline point, viscosity at 100 deg fahr. and at 210 deg. fahr., kinematic viscosity index, and boiling point at 1 mm. Hg. The sulphur, oxygen, and nitrogen content and the value of x in the expression C_nH_{2n+x} have also been considered.

Conclusions are drawn concerning the chemical constitution of the entire lubricant fraction exclusive of the "wax" and the "asphaltic" material.

Running Tour
WITH MEN IN THE INDUSTRY

I. H. HUGHES, who has been district engineer in the Panhandle for Phillips Petroleum Company, Production Department, has been promoted to engineer in charge of electrical pumping equipment. His headquarters will be at Bartlesville, Oklahoma. For several years he was with Black, Sivalls and Bryson.

JAMES A. VEASEY, general counsel of the Carter Oil Company, Tulsa, Oklahoma, for the last 23 years, will retire November 1st, it has been announced. He reaches the retirement age of 62 October 11.

JAMES A. VEASEY

LLOYD G. OWEN, who has been on the legal staff of the company for 22 years and prior to that was associated with Veasey in general law practice, will succeed to the position of general counsel.

W. A. WATKINS, superintendent of the central division of the Carter Oil Company, who has had his headquarters at Seminole, Oklahoma, has been named general superintendent of the company's eastern division and will make his headquarters at Mattoon, Illinois. He succeeds to the position made vacant by the illness of **REX L. DAWSON. R. W. KIRKPATRICK,** Wilson, Oklahoma, superintendent of the southern division, will take charge of the central division in addition to his present work and will make his headquarters either at Shawnee or Seminole.

CLARENCE A. RUSSELL, Houston, Texas, has announced his resignation as general superintendent of Pan American Production Company. He plans to enter business for himself.

NATE CONDRY, superintendent for the Cosmo Petroleum Company in South Louisiana, has been transferred to Refugio, Texas. He is being succeeded in Louisiana by **J. J. HOOPER** who has been with Cosmo at Refugio.

BART DoLAST, formerly with the Gulf Oil Corporation, is now in charge of the engineering department of the Pure Oil Company in Illinois.

THOMAS COLLINS is now in charge of operations of the Cane Creek Company on the Cane Creek structure in Grand County, eastern Utah, having succeeded **MAX LAGROSILLIERE,** drilling superintendent for the company.

J. N. HOLDEN, formerly superintendent of maintenance of the Union Oil Company of California, has been made manager of the company's Oleum refinery.

H. M. MURRAY, Isthmus, Mexico, field superintendent of the El Plan district for El Aguila, has sailed from England for Trinidad where he will be assistant drilling superintendent for the United British Oilfields of Trinidad, Ltd.

JOSEPH BOYLE, London, England, manager of the Anglo-Saxon Petroleum Company, is in the United States. He expects to return to England the latter part of September.

BERT RIDGEWAY, who has been in charge of the Michigan division of the Cities Service Oil Company, has been transferred to Mattoon, Illinois, where he will open an office for the company. **WILLIAM SCHULZ** succeeds him in Michigan.

C. E. COOK has been appointed superintendent of the Forest Oil Company and is now making his headquarters at Bradford, Pennsylvania. He has been an employee of the company for 19 years.

HENRY CARTER REA has returned from Afghanistan and is now district geologist for the Shell Petroleum Corporation, stationed at Owensboro, Kentucky.

RICHARD J. DEARBORN, president of the Texaco Development Corporation, is in England on business.

E. R. OSBURN, district superintendent of The Texas-New Mexico Pipe Line Company, has transferred his headquarters from Junction to Midland, Texas.

W. ROSS LEARD, petroleum engineer, Magnolia Petroleum Company, has been transferred from Dallas, Texas, to St. Elmo, Illinois, where he will be production foreman.

P. J. DENMAN, independent operator of Bradford, Pennsylvania, has been reappointed a trustee of Pennsylvania State College by Governor Earle.

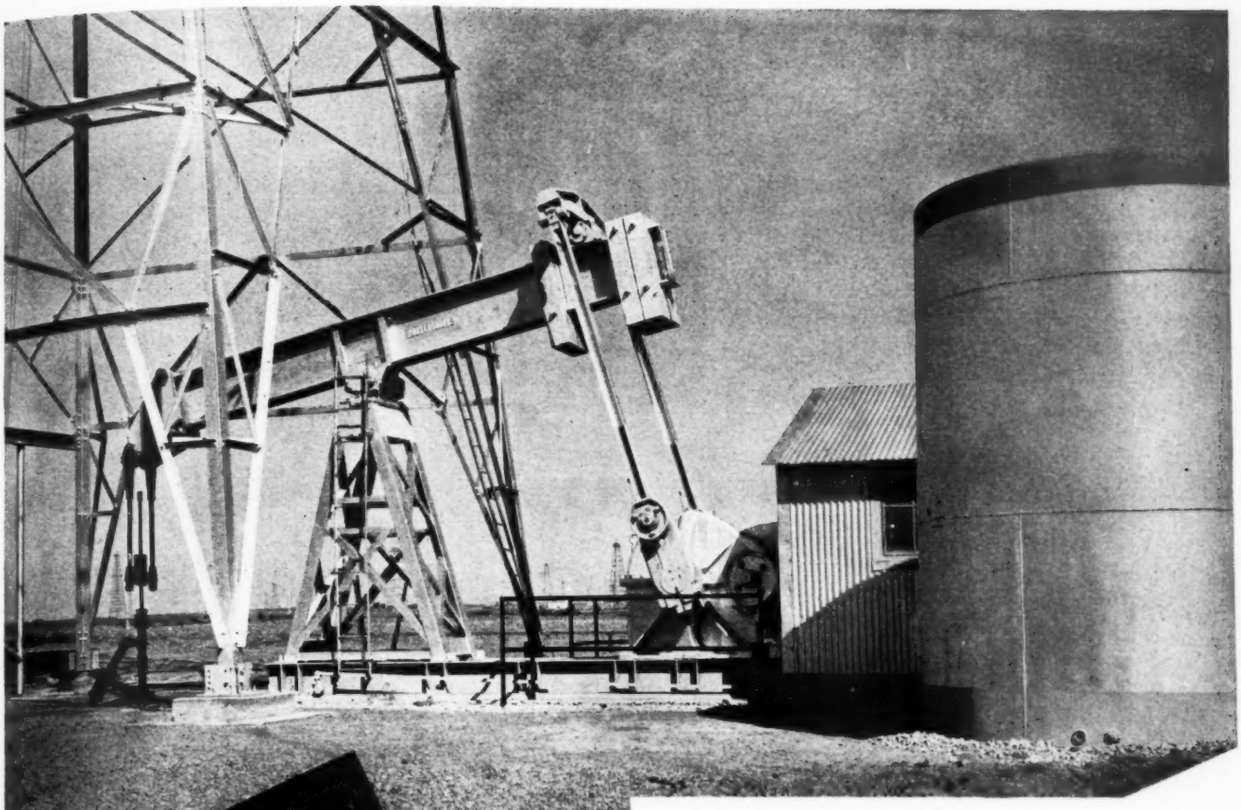
W. C. MacMILLAN has been appointed regional manager of the land department of Continental Oil Company, it is announced by **PRESIDENT DAN MORAN,** following division of the land department east of the Rocky Mountains into two regions.

W. C. MacMILLAN

W. E. HAGGARD, former manager of the department, was named manager of the southern region, having his headquarters at Houston, Texas. MacMillan will be manager of the northern region. His headquarters will be Ponca City, Oklahoma. He has been assistant manager of the land department.

CARL CLEMONS, assistant drilling superintendent in the Gulf Coast territory for Gulf Oil Corporation, has returned to Houston after a three weeks' vacation tour by automobile in Tennessee and North Carolina. Accompanying him were **MRS. CLEMONS** and his mother, **MRS. W. H. CLEMONS.**

BLAINE JOHNSTON has been named manager of the production and pipe line departments of the Crown Central Petroleum Corporation, Houston, Texas. To assume his new post he has resigned as general manager of the Johnston Oil Field Service Corp.



Note
THESE FEATURES

Oversize, flood-lubricated bearings.

•

Reinforced sills at anchor bolt foundations.

•

Leveling screws in base.

•

Split hub cranks with set screws for spreading hub.

•

"Banjo" Type Pitmans.

•

Split Nuts on engine adjusting screws.

•

Adjustable saddle bearings.

"The smoothest running units I've ever seen", is how one Production Engineer described the performance of the Parkersburg Pumping Units on his lease. Check the features, specifications and fabrication of these units and you'll also understand why they are smoother running and more efficient. Your nearest Parkersburg representative can give you complete details on the type that meets your requirements.

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PARKERSBURG
PUMPING UNITS

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LAUGH WITH BARNEY

Edited by BARNEY HORRIGAN

The sleight-of-hand performance was not going so well.

"Can any lady or gentleman lend me an egg?" asked the conjurer coming down to the footlights.

"If we'd 'ad one," shouted a man in the audience, "you'd 'ave got it long before this."

* * *

The alert Shelby (Ala.) Democrat reports the case of a man who was defeated ignominiously when he ran for the office of sheriff.

He received 55 votes out of a total of 3500, and the next day he walked down Main Street with two guns hanging from his belt.

"You were not elected, and you have no right to carry guns," fellow-citizens told him.

"Listen folks," he replied, "a man with no more friends than I've got in this county needs to carry guns."

* * *

Two WPA workers were pushing wheelbarrows of dirt. One seemed to be working a bit more strenuously than the other and a spectator was prompted to mention to the slower worker that his partner was dumping four barrowfuls to his one.

"I know it," answered the slow one. "I've told him three times about it already."

* * *

With Reservations

Anxious to prove his piety, a convert at a Negro revival approached his pastor and asked that he be put to work in the Lord's vineyard.

"What would you like to do?" the preacher asked.

"Jes' anything," replied the convert. "Ah's ready to do whatever de Lawd axes me, jes' so hit's right and honorable."

* * *

"I understand that Bette has cured her Scotch boy friend of stuttering. How did she do it?"

"She called him up long-distance, collect."

* * *

Then there was the Scotchman who married a tattooed dancer so his children could see moving pictures free.

* * *

Are the fish biting?"

"I don't know," replied the weary angler. "If they are, they're biting each other."

Labor has its closed shop and Capital has its shops closed. Now everybody should be happy.

* * *

We've often wondered what horses think of the various things people refer to as "horse sense."

* * *

Two Negroes attended a political meeting where a candidate was making a speech. In a few minutes, one said: "Mose, who is dat man?"

"I don't know," Mose answered, "but he sho do recommend hisself mos' highly."

* * *

Nit: And has she made him a good wife?

Wit: I don't know about that, but she's sure making him a good husband.

* * *

The postman came up the front walk of ye oil man whistling a merry tune in a particularly loud and provocative manner.

"What you got to whistle about?" inquired the householder.

"That I don't have to pay the bills I'm bringing you," replied the postman, resuming his merry tune.

* * *

A supply man became tired of his job and gave it up to join the police force. Several months later a friend asked the former supply man how he liked being a policeman. "Well," he replied, "the pay is good and the hours are satisfactory, but what I like the best of all is that the customer is always wrong!"

* * *

New Guest (at summer resort hotel): "Dull here?"

Old Guest: "Dull! Why, I almost wish I had brought my wife."

* * *

A little girl had been playing in the water with some other little children. Her mother asked her if she were playing with little boys or girls.

"I don't remember, Mother," she replied, "they didn't have any clothes on."

* * *

He stood at the tavern bar, happy, not a care in the world—completely, totally (perhaps)—drunk on beer. Suddenly his expression changed from raptured bliss to a worried look. Turning to a lady on his left, he said:

"Lady, did you spill some beer on my pants?"

"No, sir, I did not."

He turned to his right, but no one was there. He mumbled to himself:

"Tha's what I was afraid of—an inside job!"

* * *

"Is this a high-class town?"

"Yeah. They even got two bread lines—one for white and one for rye."

* * *

"Are you a member of the college crew?"

"No."

"Then stop stroking me!"

* * *

Bookkeeper: I'll have to have a raise, sir, there are three other companies after me.

Boss: Is that so? What companies?

Bookkeeper: Light, 'phone, and water.

—*Exch.*

* * *

What Price Silence

He: Will you ever forget that glorious week-end at Atlantic City?

She: Well, what am I offered?

* * *

All Even

Girl (at baseball game): Oh, look, we have a man on every base!

Her Girl Friend: That's nothing! So has the other side.

* * *

And How!

Aunt Addy says, "You travel in the finest circles when you drink Tom Collins."

—*St. Louis Adv. Club Weekly.*

* * *

"Let's see, you're an optimist, aren't you?"

"A kind of one. I believe the world is getting better every day; but I'm not so sure about the nights."

—*The Earth Mover.*

* * *

Thank goodness we live in a free country, where a man may say what he thinks—if he isn't afraid of wife, neighbors, or boss, and if he's sure it won't hurt his business or his reputation.

* * *

Backwoodsman (returning to his theatre seat after intermission): Did I step on your toes as we went out?

Seated Man (grimly): You did, sir.

Backwoodsman: Here we are, Matilda. This is our place.

THE INDUSTRY WANTED IT

The *New* BAKER CEMENT WASH-DOWN WHIRLER FLOAT SHOE

. . . AND HERE ARE THE RESULTS OPERATORS ARE ACCOMPLISHING WITH THIS NEW TYPE OF SHOE:

GUIDING is easily and efficiently done, due to the rounded nose of the concrete guide which leads the casing past all side wall irregularities . . .

FLOATING is safely performed due to the "Ball Type" Back-Pressure Valve which provides a leak-proof seal against either high or low pressure and affords strength beyond the collapsing point of the casing . . .

REMOVING BRIDGES & WASHING DOWN is accomplished by the downward, hydraulicking action of the circulating fluid through the baffled "Down-Whirler" ports . . .

WASHING FORMATION at the cementing point to condition the hole preparatory to cementing is another Result . . .

BETTER CEMENTING is accomplished by the definite DOWNWARD as well as the UPWARD whirling action imparted to the cement in its travel around the shoe and up and around the casing . . . this action insures best possible encasement of the pipe with a uniform body of cement.

This New Wash-Down Whirler Principle is Also Available in a GUIDE SHOE. (The Baker Cement Wash-Down Whirler Guide Shoe.)

BAKER CEMENT WASH-DOWN WHIRLER FLOAT SHOES

Have the **SAME**

STRENGTH

VALVE EFFICIENCY

DRILLABILITY

Safe for the Longest and Heaviest Strings of casing.

Baker BALL-TYPE VALVE Assures Positive Leakproof Sealing Against Either Low or High Back-Pressure.

Only special Baker Bakelite and Baker-Formula Concrete are used in the construction of Plug and Valve. Both Materials Are Easily DRILLED UP and CIRCULATED OUT OF THE HOLE.

AS FOUND IN *ALL* BAKER CEMENT GUIDING, FLOATING, CEMENTING EQUIPMENT.

Send For This New Illustrated Folder . . . or See the Baker Section of Your 1938 Composite Catalog.

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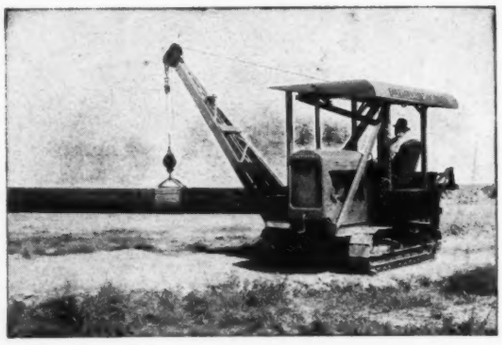
Odessa, Texas – Telephone 317

EXPORT SALES OFFICE
Rm. 1914 – 19 Rector St., New York City
Tel. Digby 4-5115

ROCKY MOUNTAIN HEADQUARTERS
Tel. 2239– Casper, Wyoming – Box 1969

MACHINERY and EQUIPMENT

Cleveland Model 90 Backfiller and Pipe Layer

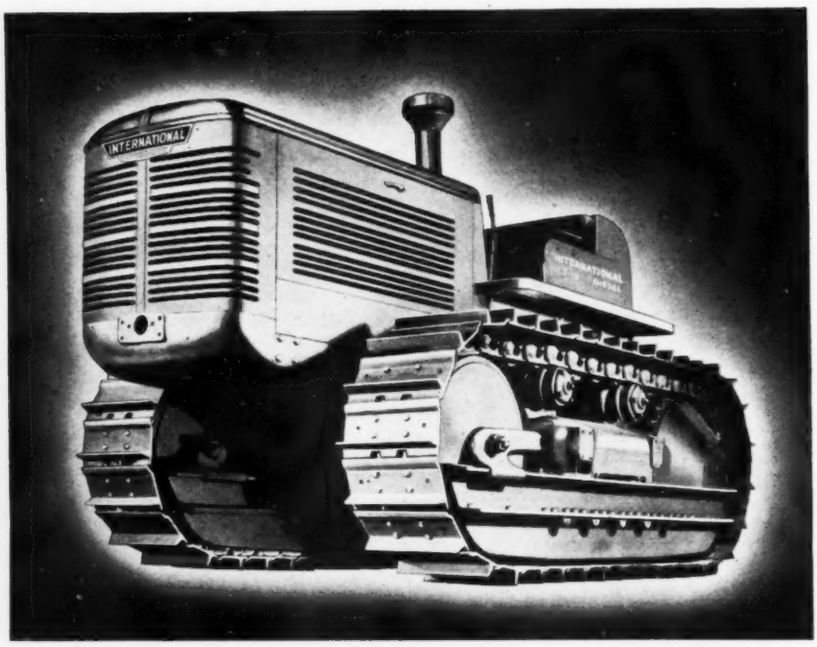


THE Model 90 pipe line backfiller and pipe layer, announced by The Cleveland Trencher Company, Cleveland, Ohio, has been designed to fill ditches faster and more economically than heretofore, the manufacturers state, special attention having been devoted to modern pipe line requirements. It is asserted that this equipment can operate on rough right-of-ways, has great stability, good ground clearance, and large track area in comparison to weight. Two of its outstanding features are that it is one-man-operated and travels in either direction at a number of speeds.

Conversion from backfilling usage to pipe handling is rapid and convenient, it is asserted. Boom, scraper, counterweights, etc., are carried along; there are no heavy manual lifts or complicated rigging-up.

Further information can be had free upon request to The Cleveland Trencher Company.

International Diesel TD-18 TracTracTor



INTERNATIONAL Harvester Company, Chicago, Illinois, is announcing its International Diesel TD-18 TracTracTor ahead of the production date, which will be about the end of the year. This model will be the largest in the International crawler-tractor line.

The flexible power of the 6-cylinder Diesel engine, having a maximum of 70 drawbar hp., combines with a 6-speed transmission to give the operator the correct power and speed for every job, the manufacturers assert. Long track ground contact and approximately 21,000 lb. of weight provide traction to match the power of the engine and the requirements of heavy-duty operation, it is pointed out. All controls and gauges are within easy reach of the operator, who rides in a comfortable seat and has good vision to the front, sides, and rear.

Gustin-Bacon Strokontrol

GUSTIN-BACON Manufacturing Company, Kansas City, Missouri, recently placed on the market a new oil-field product known as the Strokontrol. The Strokontrol is an intermittent pumping device to be used on part time oil wells. It can be adjusted to pump the well an effective number of hours slightly greater than the pumping off time, but distributed over the 24-hour period and without changing the lifting velocity.

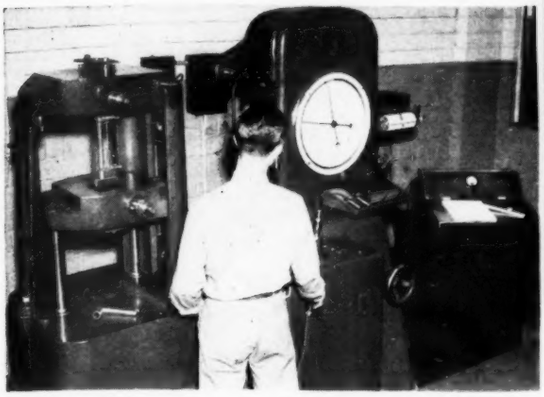
The Strokontrol is installed very easily between the central power or back crank and the knock-off post.

Increases in daily production of 10 to 50 percent have been obtained, it is asserted. This is due to the fact that the Strokontrol allows the fluid to be pumped from the hole at approximately the same rate at which it enters the hole, maintaining the proper fluid level.

The material used in the Strokontrol has been carefully selected to promote long life. Although the timing mechanism as a group is new the component parts have been in common use on machines for years. The heart of the Strokontrol timing mechanism is composed of a latch, a cam, and over-running clutches controlling the connecting and disconnecting of the well. The number of power strokes required to rotate the cam 180 deg. determines the number of pumping strokes and similarly the number of power strokes required to rotate the cam the other 180 deg. determines the number of off strokes. The pumping and off strokes, independently of each other, can easily be set for 3, 4, 6, 8, 12, or 24 strokes, permitting variation of the ratio between pumping and off strokes from 1:8 to 8:1.

1. General view of Axelson chemical and physical testing laboratory.

LIFE TESTS ON AXELSON SUCKER RODS



2. Olsen machine for testing tensile strength, elasticity and related properties. Capacity of 100,000 pounds.

3 Olsen Brinell machine for testing hardness by forcing small test ball into flattened area on specimen.

4. Test pieces, machined from forged pins, before and after fracture in tensile testing machine.

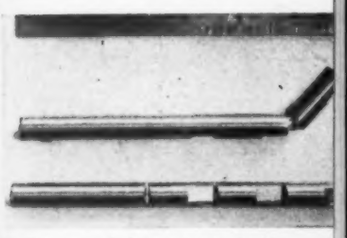
No physical examination of a human being to determine his fitness for life insurance is as thorough, as comprehensive and as drastic as the tests given to every heat of Axelson Sucker Rod Steel. When these life tests are recorded, they show what can be expected in the actual performance of the rods as to strength under load, hardness, elasticity, impact, fatigue, corrosion and other conditions.

The Axelson Testing Laboratory is the vestibule through which all materials used in Axelson products must pass for rigid, ceaseless examinations. No doctor is as ruthless in rejecting a doubtful applicant for insurance as the Axelson examiners are in rejecting materials that do not come well above the established minimum specification requirements.

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

5. Olsen Izod machine for testing resistance of specimen to shock or impact.

6. Toughness proved by blow of 120 foot-pounds delivered to notched specimen.



7 Test pieces before and after Izod impact indicating shock resistance.

AXELSON

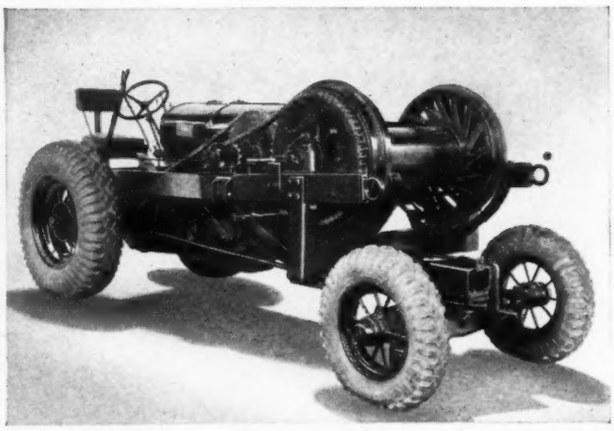
DEEP WELL PLUNGER PUMPS

SUCKER RODS

Axelson Manufacturing Company, P. O. Box 98, Vernon Station, Los Angeles • St. Louis • 50 Church Street, New York • Tulsa

Mid-Continent and Eastern Distributor: Frick-Reid Supply Corporation • *Rocky Mountain Distributor:* Great Northern Tool & Supply Company.

M. I. W. H-1 Hoist

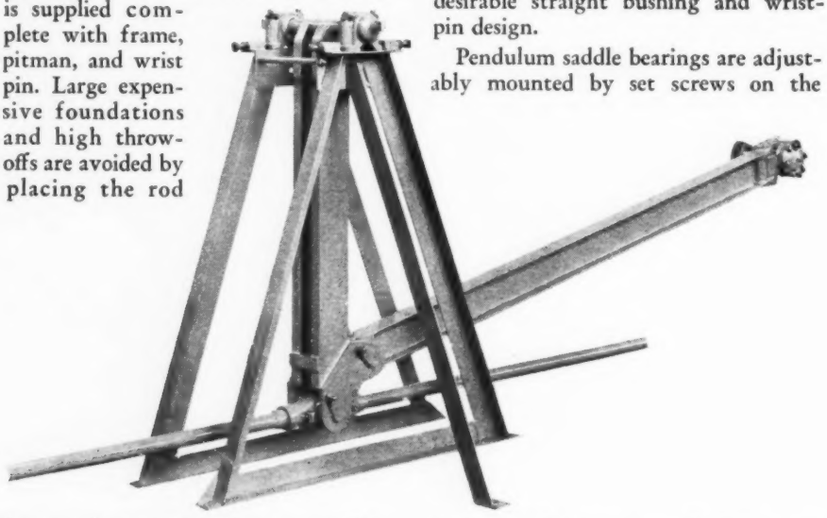


MUSKOGEE Iron Works, Muskogee, Oklahoma, announces its new H-1 hoist, mounted on the International Harvester Company's I-30 tractor, for servicing wells to 3500 ft. in depth. Developing 39 hp. at 1150 r.p.m. it is a fast and powerful unit. Six line speeds being produced through its transmission and chain reductions, from 80 ft. to 906 ft. per minute single line speed is obtained. The machine affords unusual flexibility. It pulls 12,400 lb. at 80 feet.

A special three-speed transmission is designed to fit the I-30 industrial tractor, and is mounted on the tractor to engage the bevel gear and in such a manner that the transmission is at the side of the tractor. Drum shaft is stationary and drum is free-wheeling and mounted on ball bearings. The front wheels of the tractor are moved forward to equalize the load between front and rear wheels. Hoist and hoist transmission can be mounted on the tractor either in the Muskogee Iron Works' plant or in the field. The unit is equipped with 7.50 by 18 front and 11.25 by 24 rear tires having 52-in. tread.

National Back-Crank Pendulum

THE National Type K Back-crank Pendulum has been placed on the market by The National Supply Company, Toledo, Ohio. This pendulum is designed for pumping additional wells from back-side cranks when pull-rod loads do not exceed 15,000 pounds. It is supplied complete with frame, pitman, and wrist pin. Large expensive foundations and high throw-offs are avoided by placing the rod lines as close to the ground as possible, the manufacturers state.



The frame is fabricated in halves having diagonal braces that, when assembled on the foundation, constitute a rigid structure. The pendulum arms are two steel channels and the saddle shaft is welded integrally. Arc-welded construction is used throughout. A feature of the pitman is the elimination of the ball and socket wrist pin construction in favor of a simpler and more easily lubricated design. By hinging the wrist-pin bearing housing on a large diameter pin complete self-alignment is obtained, allowing the use of the more desirable straight bushing and wrist-pin design.

Pendulum saddle bearings are adjustably mounted by set screws on the frame so that accurate alignment can be procured. These bearings are of cast iron and have oil reservoirs and perfect oil seals. Pull-rod connection, pitman, and wrist pin bearings are all of bronze and have oil reservoirs and perfect oil seals. Connection housings are made for 2⅜-in. O.D. welded pipe extensions. Proper alignment of the pipe extensions throughout the stroke is permitted by hinging the pipe socket on the pitman side to the housing.

A complete description of the National Type K Back-crank Pendulum, as well as a larger size, Type H, is given in Bulletin No. 177. Their use with National reduction gears equipped with National concentric cranks and counterweights is also discussed.

General Motors Diesel Engines Available to the Oil Industry

The Diesel Power Company, Tulsa, Oklahoma, has been appointed distributors in Oklahoma, Kansas, and Northern Texas for the new General Motors Diesel engine. This engine is the result of ten years' experimentation of the General Motors Research Department, headed by Chas. F. Kettering.

The engine operates on the 2-cycle principle, the air entering the cylinder at the bottom of the piston stroke through a blower. This blower method of scavenging the burned gases from the cylinder and past the exhaust valves permits the engine to run much cooler than otherwise would be possible, it is asserted. Because of the helical form of the rotor lobes of the blower a continuous stream of air flows into the cylinders. This is known as the uniflow principle.

The General Motors unit injector on the fuel system is one of the features of this engine, combining the high-pressure fuel pump, the metering of the fuel, and the spray nozzle all in a single, easily removable unit.

The rotating masses of the engine are completely balanced by the counterweight on the crankshaft, and the balance shaft, which runs in an opposite direction to the camshaft. Rotation of the crankshaft may be either clockwise or counter-clockwise as the installation requires.

Another feature of this engine is the location of accessories, such as the blower, water pump, oil cooler, governor, and fuel pump. These accessories may be placed either on the right or left side of the engine regardless of the direction of rotation. Also, the exhaust manifold and water outlet manifold may be on either side of the engine.

This engine weighs approximately 20 lb. per horsepower.

Officials of the Diesel Power Company are George E. Fuller, president; Carl A. Tangner, general manager; Leo H. Towers, engineer; Gene Heins and Harley T. Price, salesmen.

Fisher Philneumatic Pump

THE Fisher Philneumatic Pump, recently introduced by the Fisher Governor Company, Marshalltown, Iowa, is a deep-well gas-lift pump that operates on the principle of applying gas pressure to the top of a trapped quantity of liquid within the pump raising it to the surface and doing so with low gas-fluid ratio.

Fig. 1. Philneumatic Type No. PI Pump

The assembled pump is shown by Fig. 1. The pump is run at the end of a string of tubing in the usual manner and is set in the hole at a depth below the normal fluid level in the well. After the predetermined point of setting is reached, the tubing is rotated to the left, which, in a half turn of the packer, will unlatch the packer slips to engage the casing, and with weight of tubing string, expands the packer rubber against the inner wall of the casing, forming a tight seal.

A special hook-wall type packer is at the upper end of the pump, the pump consisting further of an oil chamber of such length as determined by the quantity and height of fluid in the hole; the chamber usually being 100 ft. in length. At the lower end, a special perforated bull plug extends downward in the hole. Through the perforated plug the oil flows upward through a stainless steel ball-type standing valve in a special collar so that the oil flowing upward must lift the ball of the ball check to flow into the oil chamber. The ball check permits formation pressures to lift it easily and allow oil flow into the chamber.

Directly above the oil reservoir chamber is another special collar and a wall into which is placed the upper standing valve. A dip tube, which goes to the bottom of the oil chamber, is screwed into a threaded opening in the special collar. Oil passing upward and out from the oil chamber must pass through the dip tube and the standing valve into the upper section of the pump. An extension of the gas admission tubing is brought through the upper section of the pump and joined and ended in the collar.

A special perforated bull plug, used on the lower end of the chamber, is normally supplied with a flush joint thread, and a special nipple having a flush joint thread to casing thread is normally used between the bull plug and collar. When the pump is subject to sand or mud or possible caving in an open hole, flush joints are recommended to eliminate possibility of the pump becoming lodged in the hole.

The pump is available for the following casing sizes: 5 3/16 in. O.D., 6⅝ in. O.D., 7 in. O.D., 8⅝ in. O.D. and 9 in. O.D.

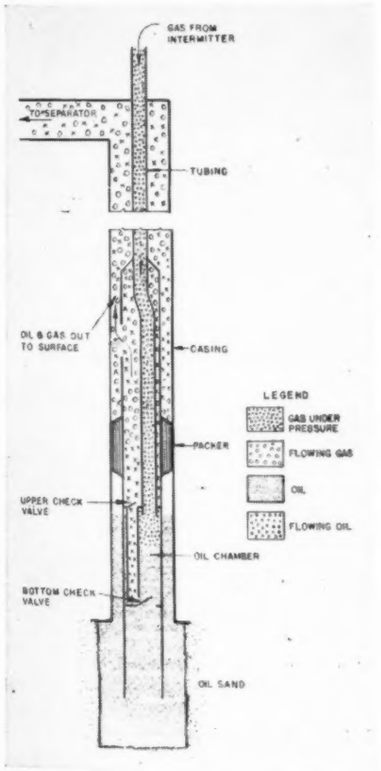
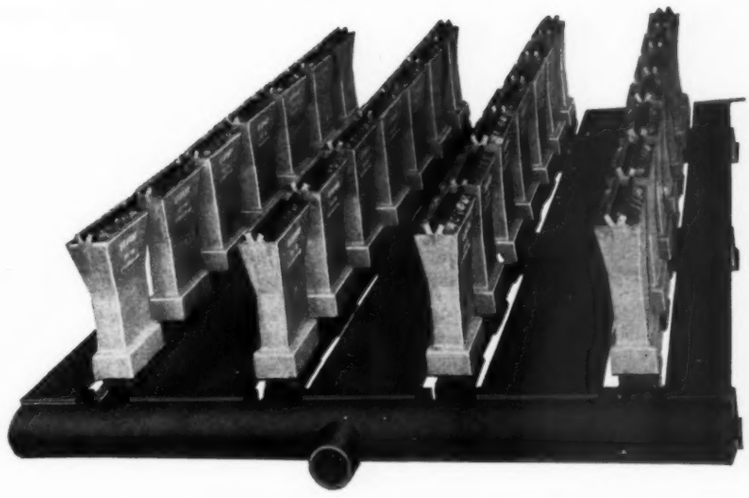


Fig. 2. Showing diagrammatically the operation of the Philneumatic No. I Pump

Hunt Tool Company Low-Pressure Gas Burner



THE Reagan improved low-pressure gas burner, a patented upright burner built in three types for all classes of oilfield boilers, is now manufactured and distributed by Hunt Tool Company, Houston, Texas, who announces full production of the unit following extensive field tests.

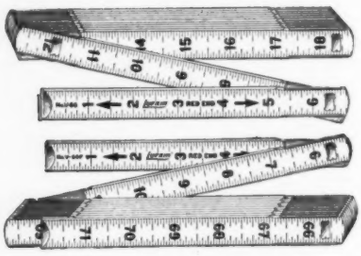
This burner features patented V-shape gas mantles rather than the conventional flat-type burner heads. Each mantle has six ¾-in. openings on each side, and is designed to throw the gas at an angle to spread an even distribution of blue flame over the entire fire-box. The mantles extend 12 in. above the boiler bottom to prevent burning the mud rim or the bottom of the boiler. Damage to the flue sheet and tubes, commonly caused by an effort to produce the main volume of steam through boiler tubes by use of stack blowers, is said to be eliminated in this improved design. The mantles are made of special heat-resisting castings asserted to be capable of withstanding fire-box temperatures without warping or burning.

The Reagan burner is mounted on 3-in. T-iron frame and welded to the feed lines, which in turn are welded in a specially-designed 3-in. gas header. Three 8-in. wide and two 4-in. wide steel plates add to the rigidity of the unit. These steel plates close the bottom of the boiler without the use of fire-brick, to the extent of automatically allowing the proper air entrance for correct air-gas mixture, and avoiding pulsation in the operation of the boiler.

An interesting feature of this burner is the ease and speed of cleaning it throughout. A 1-in. plug at each end of the gas header and a 1½-in. cap at the end of each of the four feeder lines permit cleaning in a few minutes the entire burner with a 1-in. steam hose.

Vertical "Red End" Rules

VERTICAL "Red End" rules, which are a new item in the "Red End" line of The Lufkin Rule Company, Saginaw, Michigan, have inch



numbers on both sides placed vertically, i.e., running perpendicularly from top to bottom (instead of the usual way of horizontally left to right). With the rule in either hand, vertical figures face the user directly when measuring upward or downward, yet are easy to read also when measuring right to left or left to right. The figures are never upside down to the user.

Vertical "Red End" rules are offered in 6-ft. length, in white enamel finish, and in two types, No. V-66 with outside marking, that is, with zero of both ends falling outside when the rule is closed; No. V-66F with inside or flat marking, i.e., numbering beginning on the inside face so measurement lies close to the work even with rule but partly open.

Like all "Red End" rules these are rust-proof, have solid brass strike plates, preventing wear, solid brass lock joints, reducing end play and maintaining accuracy, sections of straight grain, tough and flexible hardwood, graduations, 16ths of inches, on both edges of both sides, superior, snow white enamel finish, and ends in gloss red, most striking and attractive. They are supplied either with or without folding end hook.

HAVE YOU considered the value of surveys?

- on large leases as an assistance in solving production problems?
- in cases when wells are located near border lines?
- prior to deepening old holes?
- when having difficulties with pumping equipment?
- where water may be infiltrating?

SURWELL SERVICE

Two surveys are made for the price of one, providing a double check. Open holes are surveyed by attaching the SURWELL Clinograph to the drill stem and making a round trip as fast as the drill crew can make it.

Cased holes are rapidly surveyed by making a round trip on the wire line. From the log of an 11,500-foot well, these figures are taken:

In-run started at - - - - 10 h. 16 m. 35 sec.
Out-run completed at - - 12 h. 53 m. 47 sec.
Total time for two surveys - 2 h. 37 m. 12 sec.

Records taken every 100 feet

Self-Checking Surwel Gyroscopic Clinograph

Self-Checking SURWEL GYROSCOPIC CLINOGRAPH provides map of well at all depths, prepared from accurate photographic records, made while going in and coming out.

Self-Checking H-K Clinograph

Self-Checking H-K CLINOGRAPH for open holes only, provides permanent, accurate records of inclination and direction five minutes after removing instruments from hole.

Self-Checking SYFO Clinograph

Self-Checking SYFO CLINOGRAPH used on a wire line or as a "Go-Devil" inside the drill stem, or on sand or bailing line in open hole, affords inexpensive daily records of vertical deviation in drilling.

A NEW CORE ORIENTATION SERVICE

Sperry-Sun Polar Core Orientation does not interfere with drilling. Orientation is determined in our laboratory. No special equipment required at well. No loss of drilling time.

SPERRY-SUN WELL SURVEYING COMPANY
1608 Walnut Street, Philadelphia, Pa.

Tulsa, Oklahoma, 425 Petroleum Bldg. · Houston, Texas, 3118 Blodgett Ave. · Long Beach, Calif., 549 E. Ashby Road (1900 Block—Atlantic Ave.) · Bakersfield, Calif., c/o Elks Club, 12th and I Streets · Lafayette, La., Bonnet Building, Cor. Lafayette & W. Vermilion Sts. · Corpus Christi, Texas, 332 N. Mesquite Drive · Santa Barbara, Calif., 1409 E. Valley Road

Baroid Mud Calculator

DESIGNED to assist drillers in performing many necessary calculations in the use and control of drilling fluids, the Baroid Mud Calculator has just been prepared by the Baroid Sales Department of the National Pigments and Chemical Division of National Lead Company. This calculator is a celluloid device working somewhat in the manner of a slide rule. It is 8 in. wide and 5 in. deep.

Among its various functions the calculator enables the operator to determine quickly and easily the volume of mud in the hole, the amount of Baroid required to make a Baroid and water mud of a desired weight, and the amount of Baroid required to increase the weight of any mud to a desired point. The calculator also aids in determining the quantity of material to be used in making up an Aquagel-water mud of a desired percentage by weight of Aquagel. Finally it aids in determining the quantity of Aquagel to be used in making up an Aquagel-cement of desired weight and proper consistency.

Volumes are given in cu. ft. and bbl., and weight of mud is given in lb. per gallon, lb. per cu. ft., specific gravity, and lb. per sq. in. per 100 ft. of depth. The mud calculator may be obtained from Baroid Sales Department offices at 837 Jackson Street, Los Angeles, California; 1111 Second National Bank Building, Houston, Texas; and 502 Tulsa Building, Tulsa, Oklahoma.

4-Flame and 6-Flame Tips for Lindewelding

THE Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, announces two new multi-flame welding tips for pipe-line construction by the Lindeweld process. The introduction of these two new

Fig. 1. The 4-flame tip for position welds

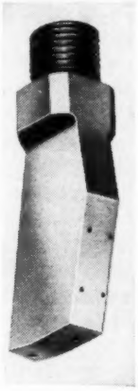


Fig. 2. The 6-flame tip for rolling welds

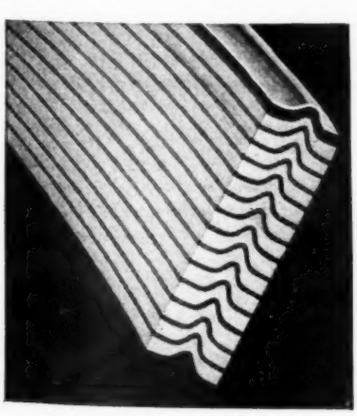
multi-flame welding tips has resulted in a speed increase of 25 percent or more and a corresponding reduction in gas consumption.

The 4-flame tip has been designed for position welds and the 6-flame tip is intended primarily for rolling welds.

The 4-flame tip provides, in addition to the main welding flame, two flames for preheating the vee and a fourth flame for preheating the welding rod. The 6-flame tip is similar to the 4-flame tip in design with the exception that it has two additional vee preheat flames, so that four flames preheat the walls of the pipe, a fifth flame preheats the welding rod, and a sixth flame does the actual welding.

Spirotallic Gaskets

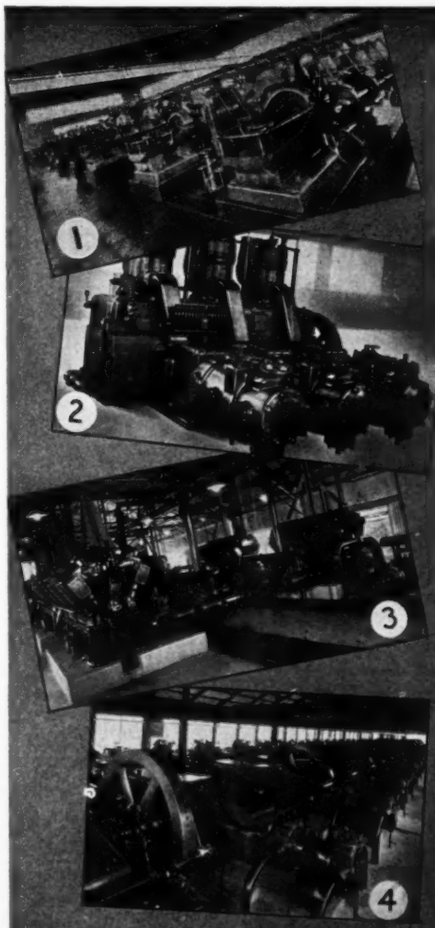
TO meet service requirements on power plant equipment operating at high pressures, Johns-Manville has developed a new type of gasket constructed of pre-formed plies of asbestos and cold-rolled, cadmium-plated steel. Known as the "Spirotallic Gasket," it is for sealing boiler manholes, handholes, and tube plates. The material is spirally wound in such a manner that the asbestos serves to seat the adjacent, interlocking metal plies. As soon as compression is encountered, the strong, rigid edges of the plies meet the bearing surfaces of the manhole, handhole, or tube plate to form a series of metal barriers that provide a tight and effective seal at extreme pressure and high temperature, it is stated.



A feature of Spirotallic Gaskets is their ability to compress under flange pressure and then to rebound when the pressure is removed. This resiliency is obtained largely by the central crimp of the interlocking plies, which provides a constant spring action that enables the gasket to compress and expand automatically as the gasketing space varies in service.

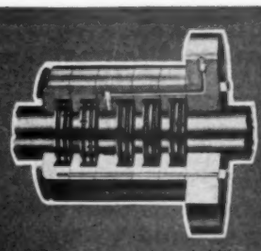
Spirotallic manhole and handhole gaskets are available in standard sizes in both round and oval form. The sizes of Spirotallic tube plate gaskets vary according to the boiler. This material is supplied in ⅛-, $\frac{3}{16}$-, and ¼-in. thicknesses.

Seal your reciprocating piston rods
the way so many engine and compressor operators do... with
COOK'S METALLIC PACKINGS



Wherever you may look throughout the oil and gas fields you will find COOK'S Metallic Packings predominating on the power and compressor rods of gas pumping and gasoline extraction engines. Noteworthy applications are represented by the engines, shown in the accompanying illustrations, that come factory equipped with COOK'S modern Packings.

Make sure you get the genuine COOK'S Packings when buying new equipment by specifying their use. For existing equipment communicate with us direct, or our nearest branch office.



1-COOPER-BESSEMER CORP.
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3-INGERSOLL-RAND COMPANY
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G-E Product Prevents Weld Spatter from Adhering to Metals

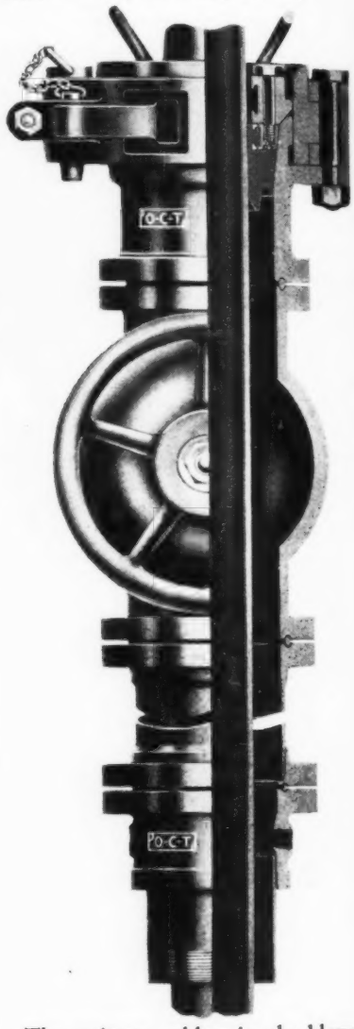
A NEW material (Glyptal No. 1294) has been announced by the General Electric Company, Schenectady, New York, for the prevention of the adhesion of weld spatter to metals. This material, which can be used without harm on any metal surface, including polished stainless steel, will not produce carbon to make the weld hard or brittle, nor will it reduce ductility, the manufacturers say. Likewise, it will not give off smoke to fog the atmosphere and it will not form gas pockets or cause the weld to be porous.

In applying the new Glyptal preparation, spraying is preferred to brushing because the former method assures a thinner coat. A thin coating will protect the work as well as a thick coating if the surface is completely covered, is more economical, and dries faster. On surfaces to be painted this material further serves as an excellent priming coat. In addition, it prevents the forming of rust on steel in storage yards. This is particularly important if the steel is to be welded.

The preparation will withstand temperatures to 600 deg. cent. for one-half hour; after this length of time it will begin to evaporate.

Blowout Preventer with Stripper Rubber

THE accompanying illustration, showing an O-C-T type "H" blowout preventer equipped with stripper rubber, flanged above a master gate, flanged spacer spool, and O-C-T type "C-7" casinghead, demonstrates the use of this equipment for running and landing intermediate casing strings under pressure. The ever-present danger of a blowout between the surface and intermediate strings has caused this hook-up to gain recognition among many operators in high-pressure areas, its makers state.



The stripper rubber in the blowout preventer readily passes pipe collars, yet effectively holds well pressures, it is stated. The entire intermediate casing string is run under blowout preventer protection except for the few minutes required to remove the stripper rubber assembly for the purpose of passing the casing hanger.

FOR
BETTER HOSE
PERFORMANCE
LONG LIFE
SAFETY and
ECONOMY

USE
GRIZZLY
ROTARY HOSE
with
GRIZZLY
ROTARY HOSE
COUPLINGS

Grizzly Steel-Armored Rotary Hose is the toughest, strongest, and most flexible possible to manufacture. When used with Grizzly Rotary Hose Couplings, it is protected against pinching and breaking of plies—common hazards of ordinary couplings. It's a combination that can't be beat—assuring the ultimate in rotary hose performance, long life, safety and economy. Use Grizzly hose with Grizzly couplings and forget about hose troubles.

E. M. SMITH COMPANY
600-650 South Clarence Street, Los Angeles, California, U. S. A.

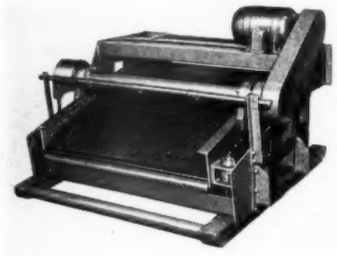
Complete Stocks Maintained in Our Warehouses at: 1121 Rothwell St., Section 16, Houston, Texas; 1008 S. E. 29th St., Oklahoma City, Okla. Export Offices Continental Emsco Co., 30 Rockefeller Plaza, New York City.

Distributed by Leading Supply Companies.

Allis-Chalmers Improved "44" Shale Shaker

ALLIS-CHALMERS Manufacturing Company, Milwaukee, Wisconsin, has announced its improved "44" shale shaker, or mud screen, designed for modern oil-well drilling.

The "44" shale shaker is a complete unit consisting of a welded-steel frame



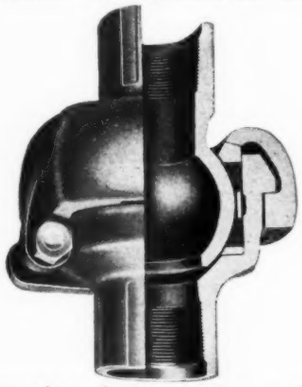
into which is incorporated a set of supporting skids, a mud box into which the screened mud is delivered, and most important, a screen member of unusual design.

This machine is complete in every respect, the manufacturers state. It is ready to set in place. All that is necessary for the operator to do is to bolt it to the trough leading from the discharge of the drilling equipment and connect the motor.

Unibolt Ball Joint

THORNHILL-CRAVER Company, Houston, Texas, manufacturers of Unibolt Couplings, have applied the patented Unibolt coupling principle to a ball joint, which is now being offered to the trade.

According to the manufacturer, the Unibolt Ball Joint presents several improvements over conventional flexible



connecting devices. (See sectional drawing). Tapered interlocking shelves are drawn together by making up on a single bolt, thus applying equal pressure on the packing entirely around the ball member. There are no threads between the component parts of the joint to gall or freeze. After the Unibolt Ball Joint has been in service for a long period of time, it may be tightened by making up on the one bolt, or the joint may be broken quickly and easily for repairs. The packing is a special composition impervious to oil, water, or gas under high pressures and temperatures. The packing rings are identical and therefore interchangeable. A spacer ring is provided between the packing rings to hold them securely in sealing position. Bronze thrust rings above and below the packing rings limit compression of the packing, effecting a metal-to-metal contact in event of undue overload.

The Unibolt Ball Joint is recommended for use on high-pressure steam lines, flexible manifolds, boiler headers, mud lines, etc., or on all conveyors of oil, water, gas, gasoline, air, and steam to take care of contraction and expansion, to simplify misaligned connections, and to prevent damage caused by intermittent vibration. It is available in cast steel only for 4000-lb. test pressure, 500-lb. steam working pressure, in sizes from 2 to 4 inch. A 1½-in. size is also available in 6000-lb. test pressure, and a 6-in. size in 2500-lb. test pressure. Misalignment is to 38 degrees, depending on the size of the joint. All parts for a given size are interchangeable.

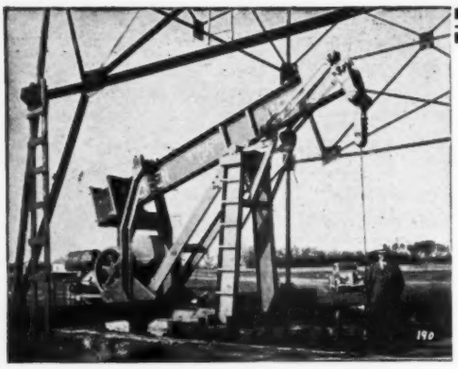
THREE important steps in making J-M 420 Rotary Lining are shown in the photo above.

The "cabled" asbestos yarn at the extreme right has been specially processed for extra strength. It is tightly woven into a dense, compact fabric; compressed and impregnated with a newly developed compound that has high resistance to heat. The result is a lining that is giving unusual service on rotary brakes. J-M 420 Rotary Lining has these important advantages:

UNUSUALLY EVEN FEED-OFF, giving better control of drilling . . . **HIGHER BRAKING EFFICIENCY,** even at extreme temperatures caused by heavy loads . . . **LONGER LIFE** under any conditions . . . **LESS SCORING OF DRUMS,** giving longer drum life.

In the short time since the new J-M 420 was introduced, this rugged, lasting lining has sold both owner and driller on its superior braking performance. For full details on J-M 420 Rotary Lining and on all J-M Friction Materials, write Johns-Manville, 22 East 40th Street, New York City.

Johns-Manville **420 ROTARY LINING**



Wells Do Better...

...when pumped with JENSEN Straight-Lift JACKS. They require less attention and produce more oil.

All pumping equipment is good, but you get better results with a JENSEN Unit. Producers have helped us perfect it. It is what they want. We have had their help with pumping equipment for 19 years.

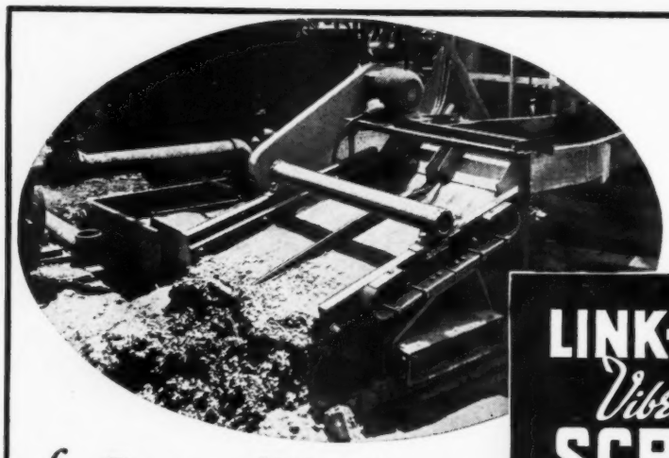
Tell us about your wells and we'll tell you what you could expect of JENSEN Jacks.

JENSEN BROTHERS MANUFACTURING CO.

. . . *Coffeyville, Kansas*

OTIS

"Don't Kill Your Well" Call OTIS



LINK-BELT *Vibrating* **SCREEN**

for **Reconditioning Rotary Mud**

● The Link-Belt screen has proved by actual performance that it is the lowest cost method of reconditioning rotary mud. It has many exclusive advantages such as—larger screening area—longer life of screen cloth—ease of transportation—minimum head room required, etc. Send for folder No. 1772. 7323

LINK-BELT COMPANY

Philadelphia Los Angeles New York Dallas Houston Tulsa

J. & L. Opens New District Sales Office

The establishment of a new district sales office for the Southwest at Houston, Texas, and the appointment of Frank D. Winslow as district sales manager has been announced by the Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

FRANK D. WINSLOW

The importance of the Southwest as a growing factor in steel consumption prompted Jones and Laughlin to establish Houston as a mill depot for a complete stock of oil country tubular goods as a means of better service to its customers.

Winslow is a newcomer to the Jones and Laughlin organization. He has represented various steel companies in the Chicago territory and the Southwest since 1920, and since 1933 has been in the Southwestern territory for a large mid-west steel manufacturer.

Curt C. Noel, district sales representative, will be in charge of the Dallas branch office, which will be under the jurisdiction of Winslow. Noel has been with Jones and Laughlin in the Southwest for many years.

J. W. Meriam of Lincoln Electric Retires

Announcement has been made of the retirement of J. W. Meriam, for the last 24 years vice-president and secretary of the Lincoln Electric Company, Cleveland, Ohio. Meriam's retirement, at the age of 60, closes a business career that spans the growth and development of the arc-welding industry.

J. W. MERIAM

Although retiring from active service, Meriam will remain a director of the Lincoln company. The company's credits and collections will be handled by Frank K. Griesinger. A. F. Davis, vice-president, has been elected secretary.

Fred A. Miller, Dresser Official, Dies

Fred A. Miller, honorary chairman of the board of S. R. Dresser Manufacturing Company, died August 22, at Beechwood, his home at Bradford, Pennsylvania. Death was attributable to a heart ailment. He had been in failing health for several months.

Long a prominent figure in the growth of the gas industry, Miller was for 35 years associated with S. R. Dresser Manufacturing Company, Bradford, manufacturer of pipe couplings for gas lines. Joining Dresser January 1, 1903, he became successively secretary-treasurer, and in 1911, president, upon the death of Solomon R. Dresser, who was the original founder of the company in 1880. In 1929, Miller was made chairman of the board of directors. He resigned from this position May 27, 1938, on his 70th birthday. The directors later named him honorary chairman in recognition of his valuable services to the company.

FRED A. MILLER

Born May 27, 1868, at Belmont, N. Y., Miller came with his family to Bradford at the age of 12 and resided there until his death. A prominent citizen of Bradford, he was a director of the Bradford National Bank for 30 years, held membership in many local clubs, and was a 32nd Degree Mason.

Survivors include his widow, Mrs. Ione Dresser Miller; a son, W. Frank Miller, of Bradford; two daughters, Mrs. C. N. Pfohl, jr., of Bradford, and Miss Margaret Miller, of New York City; two sisters, Mrs. Elizabeth Bannon and Mrs. A. A. Armstrong, of Bradford, and six grandchildren.

Private interment was held August 24 at Oak Hill Cemetery, Bradford.

STOP *Thread Leaks*

with this **NEW**

PROVEN DISCOVERY!

Patent Pending

RECTORSEAL is not a thread "dope." It does not compete with compounds commonly made by oil companies to prevent corrosion of threads on racked pipe. RECTORSEAL is a **thread leak preventer,** especially prepared for oil industry connections. Unlike **all** other thread fillers, RECTORSEAL not only seals, but permits breaking the joint easily at any time. Buy it from your Supply Store in container size to fit your need.

Made by the makers of
RECTORHEAD
Successor to the Bradenhead

RECTOR WELL EQUIPMENT CO., INC.
HEADQUARTERS: Fort Worth, Texas. BRANCHES: Houston, Wichita Falls, Midland, Corpus Christi, Los Angeles, Tulsa, Shreveport, Casper.

DIAPHRAGM KEEPS FLUID OUT OF WORKING PARTS

The self-contained diaphragm of the Abercrombie Pressure Gauge positively prevents the line fluid from entering any part of the gauge mechanism... an essential requirement of any gauge measuring drilling mud pressures. The self-contained dampening mechanism gives uniformly steady pressure readings over the entire pressure range, without adjustments.

Full details are yours for the asking

ABERCROMBIE PUMP CO.
GULF BLDG. HOUSTON TEX.

Sperry-Sun Personnel Changes

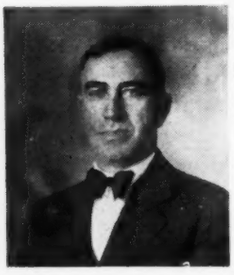
DWIGHT C. ROBERTS W. H. EMERSON

Dwight C. Roberts has been appointed manager of the Pacific Coast region by the Sperry-Sun Well Surveying Company and has charge of all company activities in the West Coast area. His headquarters are at Long Beach, California.

W. H. Emerson has been appointed manager of the Long Beach district and will make his headquarters in that city.

Death Takes John McNally

John M. McNally, division superintendent of Stanolind Pipe Line Company, having his headquarters at Tulsa, Oklahoma, died at the age of 59 years at his home, 1375 East 26th Place, Tulsa, August 12th.



J. M. McNALLY

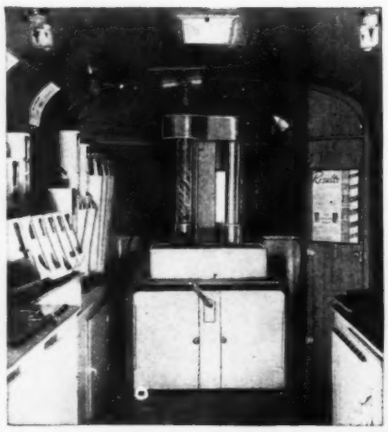
McNally was born at Sayer City, Pennsylvania, October 1, 1879, and grew to young manhood in the oil-field country of that state. His first employment in the industry at the age of 21 years was with the National Transit Pipe Line Company, as a field gauger. Later he served four years with the Buckeye Pipe Line Company in Ohio. His next employment was with the Illinois Pipe Line Company at Elwood, Indiana, where he remained for eight years. With the development of the oil fields in the Southwest, he came to Oklahoma in 1914 and served as a gauger at Owasso and Nowata for the Prairie Pipe Line Company. In September, 1919, he joined the Sinclair pipe line organization and served as a gauger. In April, 1920, he was promoted to district foreman with headquarters at Hominy, Oklahoma, and in September, 1922, was made division superintendent with headquarters at Okmulgee. McNally continued as division superintendent in the organization which became the Stanolind Pipe Line Company in October, 1930. He was in direct charge of the company's operations in such "boom" oil fields as Cromwell, Seminole, Oklahoma City, and Fitts, which made him well known among the oil men of Oklahoma. During the last three years, his headquarters have been in the general office at Tulsa, Oklahoma.

Baker Oil Tools Builds Unusual Rolling Exhibit

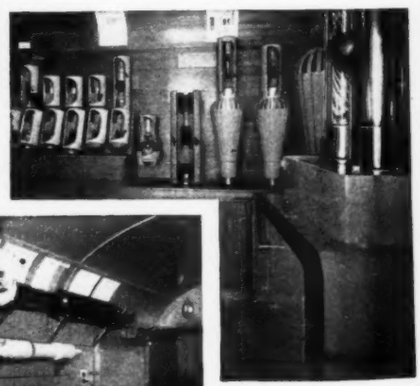
"An Oil Tool Education on Wheels" is a most appropriate description of the new demonstration trailer designed by Baker Oil Tools, Inc., to be used as a travelling exhibit displaying virtually their entire line of specialty oil tools, particular emphasis being given to the new Baker cement wash-down whirler float shoe and guide shoe.

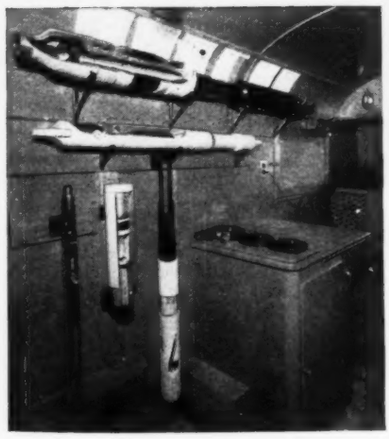
Well in advance of the trailer's visit, an announcement of the time and date of its arrival will be posted in leading oil well supply stores along the route. The itinerary on which the Baker Rolling Exhibit has already embarked will include more than half of the 48 states, and it is estimated will cover more than 40,000 miles. It is also anticipated that two years will be required to contact the various domestic oil fields that Baker now serves with its line of "Practical and Dependable" oil tools.

(Above) Showing exterior view of custom made Baker Rolling Exhibit. Both trailer and coupe are painted the well known Baker colors of yellow and blue.



(Left) One of the highlights of the exhibit is this unique demonstration unit illustrating the effective whirler action of the Baker Cement Wash-Down Whirler Float Shoe and Wash-Down Whirler Guide Shoe.





(Right) Interior view showing cutaway models of Baker Cement Retainer, Baker Wall Scraper, Baker Model "B" Drill Pipe Float, Baker Cable Tool Core Barrel and Baker Cement Dump Bailer. Cabinet containing the ice box is to right, and in the back end can be seen part of the divan which at night makes up into a double bed.

(Above) Interior view showing special built scale models of some of the units comprising the Baker line of Cement Guiding, Floating, and Cementing Equipment.

Well Equipment Manufacturing Corporation Celebrates Fourth Anniversary

Well Equipment Manufacturing Corporation, Houston, Texas, organized in June, 1934, as an oil equipment sales company, celebrated its fourth anniversary recently by opening a new office building and manufacturing plant. Since 1934 the "Weco" organization has increased its personnel from two to more than 40 employees, including a staff of 12 salesmen, who travel the Mid-Continent territory.

New building of Well Equipment Manufacturing Corporation

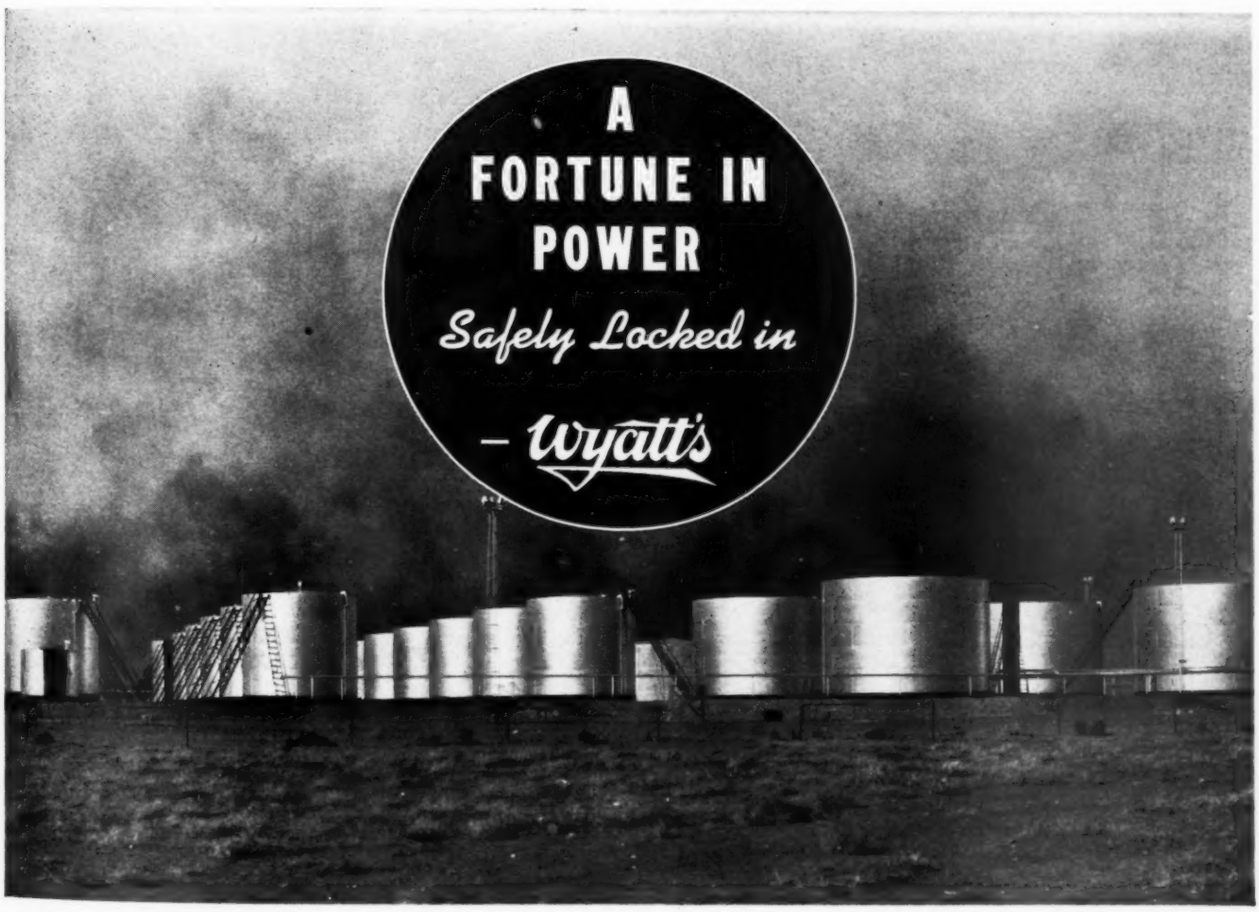
From a 10-ft. by 18-ft. one-lathe shop, the plant has grown to such large proportions that it is now housed in a modern stucco building of 10,000 sq. ft., situated on the site of the original shop at 2025 Semmes Street.

The "Weco" line of manufactured products includes "Weco" wing unions, oil savers, stuffing boxes, boiler gauge cocks, valve speed handles, tubing discs, tubing disc breakers, universal combination or CC clamps, emergency pipe clamps and service saddles, and drop side snatch block.

In addition to its own manufactured products, the company also is sales agent for the following manufacturers: Hamer Oil Tool Company, The Okadee Company, Gulf Lubricator Company, Real-Fire Burner Company, Boiler Equipment Supply Company, Kibele Manufacturing Company, Justiss Manufacturing Company, and Lewis Manufacturing Company.

C. K. STILLWAGON

C. K. Stillwagon, president and general manager of the Well Equipment Manufacturing Corporation, started his career in the oil industry in 1915 as a roustabout for Steele Brothers Drilling Company in the Pennsylvania oil fields, and moved the first string of tools into the Big Lake oil field with the late Carl Cromwell, where a well was drilled on the Hamen Krupp, Santa Rita No. 1, which was the beginning of the West Texas oil fields. Subsequent experience was with National Supply Company, Texhoma Oil and Refining Company, which later was purchased by Continental Oil Company, and representative for Mission Manufacturing Co.



After a long, tiring drive it's surely a happy sight to see an Affiliated National Hotel.

Yes, it's the best part of the trip to be able to rest and relax in a hotel that emphasizes courtesy and service as do the thirty-three

Affiliated **NATIONAL HOTELS**

ALABAMA
THOMAS JEFFERSON ..... Birmingham

ILLINOIS
HOTEL FAUST ..... Rockford

LOUISIANA
JUNG HOTEL ..... New Orleans
HOTEL DESOTO ..... New Orleans

MISSISSIPPI
HOTEL LAMAR ..... Meridian
HOTEL RIVIERA ..... Biloxi

NEBRASKA
HOTEL PAXTON ..... Omaha

NEW MEXICO
HOTEL CLOVIS ..... Clovis

OKLAHOMA
OKLAHOMA BILTMORE ..... Oklahoma City
HOTEL HUBER ..... Muskogee
HOTEL BELMONT ..... Okmulgee
HOTEL SAPULPA ..... Sapulpa
HOTEL ALDRIDGE ..... Wewoka

TEXAS
STEPHEN F. AUSTIN ..... Austin
HOTEL SETTLES ..... Big Spring
HOTEL BROWNWOOD ..... Brownwood
HOTEL SOUTHERN ..... Brownwood
HOTEL LAGUNA ..... Cisco
HOTEL CLIFF TOWERS ..... Dallas
HOTEL DONNA ..... Donna
HOTEL CORTEZ ..... El Paso
HOTEL TEXAS ..... Fort Worth
HOTEL BUCCANEER ..... Galveston
HOTEL JEAN LAFITTE ..... Galveston
CORONADO COURTS ..... Galveston
MIRAMAR COURT ..... Galveston
HOTEL CAVALIER ..... Galveston
HOTEL LUBBOCK ..... Lubbock
HOTEL FALLS ..... Marlin
HOTEL GHOLSON ..... Ranger
HOTEL CACTUS ..... San Angelo
ANGELES COURT ..... San Antonio

VIRGINIA
HOTEL MOUNTAIN LAKE ..... Mt. Lake

AFFILIATED
NATIONAL HOTELS
HOST TO THE NATION
H-8-232

Jones and Laughlin Enters Wire Rope Field

In their program of expansion the Jones and Laughlin Steel Corporation has entered into the field of wire rope manufacture, having erected a modern plant. The plant is known as the Gilmore Wire Rope Division of the Jones and Laughlin Steel Corporation. Gilmore, a leader in the wire rope industry, who is general manager of this division, together with his engineers, has recognized the need for entirely new precision machines to meet present-day demands. These have been installed.

ROBERT GILMORE

This modern plant is indicative of an expansion and development program carried on by Jones and Laughlin under the direction of H. E. Lewis, its president, who says:

"The entrance of Jones and Laughlin into the manufacture of wire rope enlarges considerably our opportunity for satisfactory return on raw materials and for better operations of our rod and wire mills.

"The plant at Muncy, Pennsylvania, is new in all respects and incorporates features for the manufacture of products having excellent qualities that will assure our immediate participation in all major markets for wire rope.

"In Robert Gilmore, general manager, we have an outstanding leader in the wire rope industry to head this new division of Jones and Laughlin."

Jones and Laughlin's new wire rope plant

McCartney in Charge Export and Eastern Coastal Sales for Clark Bros. Company

ROBERT R. McCARTNEY

According to a recent announcement by J. B. O'Connor, vice-president of Clark Bros. Company, Olean, New York, manufacturers of engines and compressors, Robert R. McCartney is now in charge of export and eastern coastal sales and engineering matters for the company.

Before joining Clark Bros. in April of this year, McCartney had been associated for a number of years with the Gulf Oil Corporation in their New York office. Prior to his employment with Gulf he spent ten years in the pump and engine division of the Worthington Pump and Machinery Corporation, after graduating from the Pratt Institute of Mechanical Engineering in 1924.

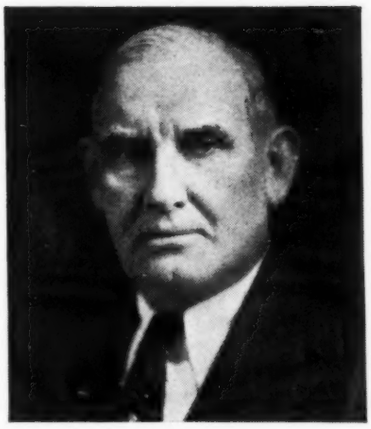
McCartney has his headquarters in the New York office of Clark Bros. Company.

New Continental Store

Another Illinois branch of The Continental Supply Company has been opened at St. Elmo. This store is supervised by J. B. Sparks, who formerly was store manager for the company at McPherson, Kansas.

W. J. Wyatt, Dallas Manufacturer, Dead

W. J. Wyatt, president of Wyatt Metal and Boiler Works, which he founded 25 years ago and built to one of the largest industrial plants of its kind in the nation, died in a Dallas, Texas, hospital August 26 from a heart attack. Born in Tennessee in 1866, Wyatt moved to Dallas at the age of 23 and shortly thereafter began working in a metal shop and attending night school. With $1,000 in savings he later formed his own metal and boiler firm, which today has grown to a $1,500,000 company.



W. J. WYATT

Byron Jackson Company Opens Houston Plant

The Oil Tool Division and the Pump Division of Byron Jackson Company moved into their new office building, manufacturing plant and warehouse in Houston, Texas, on September 1.

The complete line of BJ oil tools previously maintained at Fort Worth is now stocked in Houston. The plant is provided with equipment to manufacture certain items heretofore made in Los Angeles, and has complete facilities for the proper service and repair of all BJ tools.

A modern heat-treating plant, believed to be the only all-electric unit in the South, will assure accurate control of all heat-treating operations, officials of the company assert.

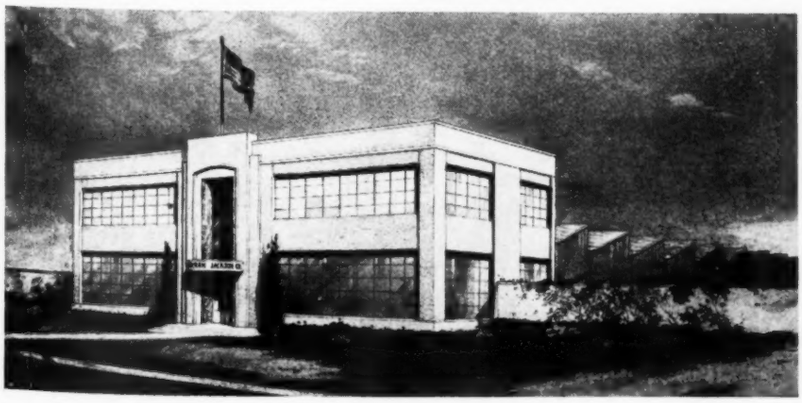
T. W. Jurling is the Houston plant manager of the Oil Tool Division, with E. R. Crawford as shop superintendent. H. E. Grau, chief engineer and works manager, will continue to supervise all engineering and plant operating activities. Jurling, for the last six years an engineer and metallurgist at the Los Angeles plant, is a graduate of California Institute of Technology, where he also completed post-graduate work in metallurgy. Crawford has a background of many years' shop experience in the manufacturing of BJ tongs and elevators, including the proper servicing and repairing of these tools.

C. F. Vincent continues as Mid-Continent manager of the Oil Tool Division, in charge of sales in the Gulf Coast and Mid-Continent areas. R. T. Todd, for several years sales representative in the Gulf Coast, will make his headquarters at the new Houston plant. Frank Champion, general sales manager for the Oil Tool Division of Byron Jackson Company, retains supervision of sales, and will spend a considerable portion of his time in the Gulf Coast and Mid-Continent, as in the past.

In addition to a staff of sales representatives, standard parts for Byron Jackson pumps will be available, and emergency service rendered. E. W. Upton, recently transferred to the Gulf Coast and Mid-Continent as district manager, will be in charge of all pump division activities.

Inquiries and orders should be directed to Byron Jackson Company, 6247 Navigation Boulevard (Mail Address, Drawer 2198) Houston, Texas; Telephone Woodcrest 6-4441. The office and warehouse, formerly at Fort Worth, has been discontinued.

A cordial invitation is extended to all oil men to visit and inspect the new Houston plant.



THERE'S SOMETHING NEW AT SECURITY!
AND HERE'S THE INFORMATION
SECURITY
LEAD SEAL PACKER
with Circulating Joint
Here's a new production packer that has already made a big name for itself in California multiple production work. For positive simplicity and fool-proof operation you've never seen a packer like it...
★ You just run it in the hole and it sets automatically at exactly the right spot.
★ It positively cannot be set too high or too low in the well.
★ It releases instantly with only a straight pull.
★ It is available both in steel and "Securaloy"—the new drillable oilfield metal!
THE SECURITY CIRCULATING JOINT, when used in conjunction with the Lead Seal Packer, provides a means for circulating between strings to bring in the well, clean out sand, etc. A straight lift on the production string opens circulating ports in each side of the joint. In the closed position these ports are made fluid-tight by a lead seal ring. Available in both steel and "Securaloy"—the new drillable oilfield metal.
Write today for illustrated bulletin describing these outstanding new devices!
SECURITY ENGINEERING CO., INC.
WHITTIER, CALIFORNIA
Export Security Engineering Co. Inc. • 420 Lexington Ave. N.Y.C.
Seamless Reamers • Securaloy • Security Drillable Products

American Gas Association Plans Large Meeting

The 20th annual convention of the American Gas Association will be October 10, 11, and 13, at Atlantic City, New Jersey.

Three general sessions will be held in the ballroom of the Atlantic City Auditorium, and sectional and departmental meetings will cover in detail specialized problems within the scope of their activities.

N. C. McGowen, president of the United Gas Pipe Line Company, Houston, Texas, and this year's president of the American Gas Association, will preside throughout the convention.

DR. E. R. WEIDLEIN

Among the speakers whose remarks will be followed with great interest will be Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, Pittsburgh, Pennsylvania. He will have for his subject "The Aid of Research to Industry."

Alexander M. Mahood, president of the National Association of Railroad and Utilities Commissioners and a member of the West Virginia Public Service Commission, will address the convention on the developments in the broad field of utility regulation.

The gas industry's participation in the two large expositions opening in 1939 will be outlined to convention delegates. The New York World's Fair will be discussed by Floyd L. Carlisle, chairman of the board, Consolidated Edison Company of New York, Inc., and the Golden Gate International Exposition by R. E. Fisher, vice-president, Pacific Gas and Electric Company, San Francisco.

ALEXANDER MAHOOD

FLOYD L. CARLISLE

The manufacturers' point of view will be presented by Merrill N. Davis, executive vice-president of the S. R. Dresser Manufacturing Company, Bradford, Pennsylvania, and president of the Association of Gas Appliance and Equipment Manufacturers.

R. E. FISHER

DR. J. BRIAN EBY

One of the high points of the natural gas sessions will be a paper on "Geophysical Methods of Explorations," presented by Dr. J. Brian Eby, consulting geophysicist of Houston, Texas.

Under the subject "Why Not Eliminate the Waste?", Elmer F. Schmidt, vice-president and operating manager of the Lone Star Gas Company, Dallas, Texas, will discuss certain phases of repressuring and re-cycling of gas. His paper will be presented before the meeting of the Natural Gas Department.

ELMER F. SCHMIDT

M. N. DAVIS

Trade Personals

M. E. MONTROSE, Gulf Coast Division manager of Lane-Wells Company, announces MORTON T. HIGGS has been made division sales manager; D. B. MCCUTCHEN, division operating superintendent; G. E. MATTER, division foreman of the Underground Survey Department; C. W. BARNES, division foreman Directional Drilling Department; and P. M. TERRILL, division credit manager. The directional drilling and well surveying departments are recent additions to the gun-perforating and other technical service departments that have constituted the company's operations in the past.

M. C. DAVIS has been appointed representative in the Rocky Mountain territory by the Rector Well Equipment Company, Fort Worth, Texas. Davis is working out of Casper and Parkerton, Wyoming, on the sale of Rectorheads and the company's new thread filler, Rectorseal.

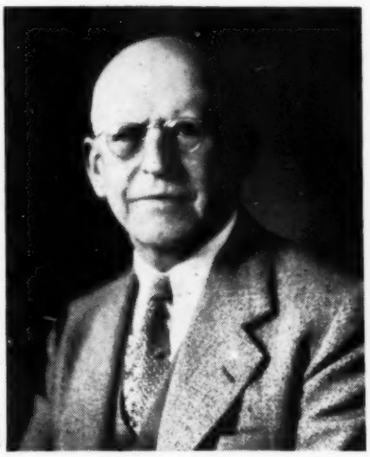
ED ROBERTSON, executive vice-president of Houston Oil Field Material Company, returned to Houston, Texas, recently from a vacation trip to California and the Rocky Mountains. He was accompanied by Mrs. Robertson. They stopped at Denver for an extended visit on their return trip.

FRANK D. NEWBURY has been appointed manager of the New Products Division of the Westinghouse Electric and Manufacturing Company, to succeed HERBERT MYGATT WILCOX, who died July 28.

J. C. BARNABY, former manager of Worthington Pump and Machinery Corporation's oil and gas engine application division at Buffalo, New York, is being placed in charge of special engineering work covering engine research and design, and will devote his entire time to this acivity. W. E. WECHTER, in charge at New York of the corporation's engine sales in the Atlantic division, has been transferred to Buffalo to succeed Barnaby.

S. P. TSCHAPPAT, general manager of the Hercules Tool Company, Tulsa, Oklahoma, is back at his desk after spending several days with his mother in Bellaire, Ohio. Before returning, Tschappat engaged in sales activities in Illinois, Indiana, and Kentucky, where he also studied drilling and production problems.

Jasper H. Fisher Passes Away



JASPER H. FISHER

Jasper H. Fisher, who for more than 25 years had been the active head of the Fisher Governor Company, Marshalltown, Iowa, pased away in St. Joseph's Hospital at Orange City, California, recently, where he had been a patient since April 1st. Funeral services were held at St. Paul's Episcopal Church, Marshalltown, and burial was in the family lot at Riverside Cemetery.

The deceased is survived by his widow and their four children, Mrs. R. L. O'Toole, Martha Ellen Fisher, Allan Fisher, and J. William Fisher.

Fisher was born in Marshalltown on September 6, 1878, the son of Mr. and Mrs. William Fisher, the founder of the Fisher Governor Company. He was educated in the public schools of Marshalltown and attended Iowa State College at Ames. Afterwards he spent a number of years in sales work before becoming associated with the Fisher Governor Company. The organization at the time Fisher joined the Fisher Governor Company consisted of only 14 people, and today includes approximately 300. When he became associated with his father's manufacturing business, the company was making only two or three types of automatic controls. Today it is producing more than 157 types of various controls such as pump governors, liquid level controllers, automatic pressure regulators, gas pressure controls, and steam traps. Fisher was especially well known in the petroleum industry, where his company had pioneered many outstanding developments of automatic control equipment during the last ten years.

To Distribute Le Roi Units

Southern Engine and Pump Company, Houston, Texas, recently acquired the exclusive distribution for The Le Roi Company, Milwaukee, Wisconsin, whose products comprise engines, compressors, and electric generating sets for general oilfield, drilling, pumping, and pipe line applications.

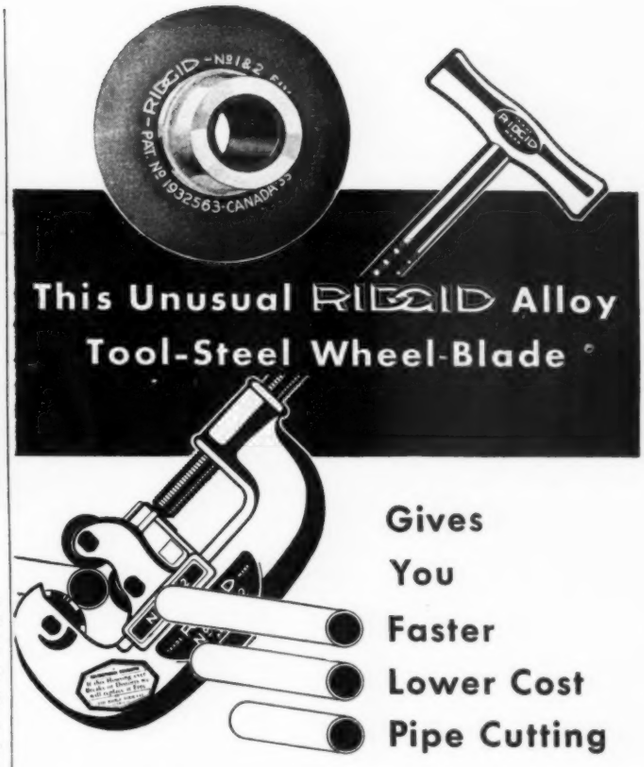
LINN K. PARK

Southern Engine and Pump Company will maintain sales offices at Houston, Dallas, Kilgore, and Brownwood, and will offer service facilities through the Houston and Kilgore stores.

Announcement also has been made that Linn K. Park, Houston, has joined the staff of the Southern Engine and Pump Company and will be in charge of engine sales.

Mid-Continent Opens New Store

The Mid-Continent Supply Company, with general offices in the Mid-Continent Building, Fort Worth, Texas, recently opened a new store at Magnolia, Arkansas, with C. M. Fleeman as store manager under the supervision of S. W. Backus, district manager at Shreveport, Louisiana.



Your skill at mechanics makes it easy for you to see why this RIDGID Cutter with its new style wheel-blade can cut pipe more quickly and cleanly and last far longer, giving you extra economy.

For the RIDGID knife-like blade is coined out of fine tool steel, hammered, heat-treated and then assembled in the hub. That's what gives it the unusual stamina for hundreds of extra cuts, reducing cutter wheel expense, as thousands of users know.

Powerful housing, guaranteed warp-proof, always cuts true, twirls easily to your pipe size. You like the "feel" of this tool, enjoy working with it.

For time and expense saving and a tool you get a "kick" out of owning and using, buy the RIDGID Cutter — at your Supply House.

THE RIDGE TOOL CO., ELYRIA, OHIO

Stop 75% of your pipe wrench repairs with this famous RIDGID

That guarantee is your assurance that you won't have any expense for wrench housing repairs — nor the annoyance of wrenches out of commission. Buy from your Supply House.

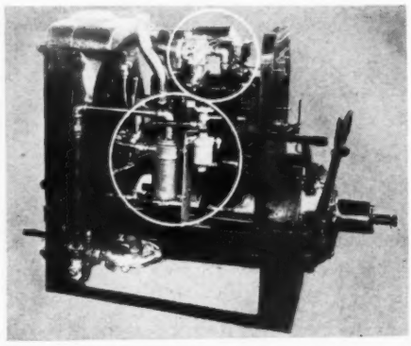
RIDGID PIPE TOOLS

LEADING ENGINE BUILDERS CHOOSE ENSIGN

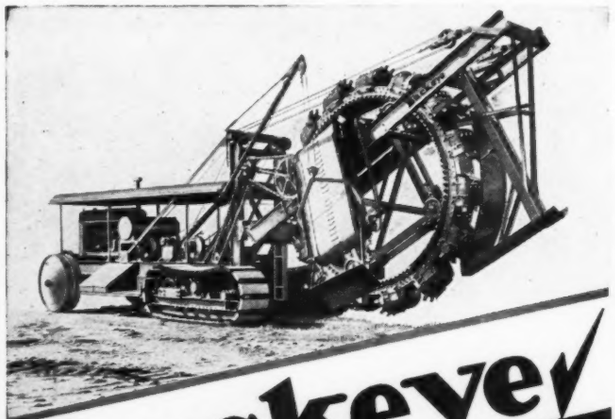
International oil field power units have established many records for operating economy and efficiency. ENSIGN Natural Gas Carburetors are factory equipment on these engines. ★ Since 1911, ENSIGN has been making accurate carbureting equipment. Today, more than 90% of the leading engine manufacturers use ENSIGN products. ★ For the BEST in Carburetors, (Gasoline, Natural Gas, Butane-Propane, Combination Gas and Gasoline)—use ENSIGN!

INTERNATIONAL

P-12 Power Unit... for Oil Well Pumping equipped with ENSIGN Carburetor for Butane or Natural Gas fuels.



ENSIGN CARBURETOR CO.



Buckeye

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Buckeye Ditchers are used on pipe line work the world over because the men who build pipe lines know that they can depend upon Buckeye Ditchers to get the job done - on time - and at the lowest year around cost. Experience proves it.

THE Buckeye Traction Ditcher Co.
FINDLAY, OHIO

BID THE Buckeye WAY • ask for our operation data before you bid •

Personnel Changes Announced by Lane-Wells

Extensive changes in personnel, duties, and progressive plans for development and expansion of the company have been announced by Walter T. Wells, president of the Lane-Wells Company, effective as of September 15, 1938. Coincident with this statement by Wells is the disclosure by W. G. Lane of his retirement from active participation in the direction and management of the company. Lane's retirement is not entirely a surprise to the oil fraternity, many members of which have been aware for some time of "Bill's" poor health. Lane retains a substantial stock interest in the company.

Rodney S. Durkee, formerly comptroller of the Socony-Vacuum Company, Inc., of New York City, and for many years closely associated as officer and director of major oil companies, has been elected executive vice-president with offices in Los Angeles.

Norman L. Dorn, chief engineer in charge of operations, and M. E. Montrose, manager in charge of Gulf Coast Division, have been elected to the board of directors, which includes, in addition to Wells and Durkee, Miss B. G. Peters, who has been a member of the board of directors since the company was organized. These additions bring to the board of directors men long experienced in oil field service operation and give representation to every division of the company's engineering and field organizations.

Sales of Lane-Wells products and services have reached an annual volume of more than $2,000,000, according to Wells, and the general condition of the oil industry presages a continuance of these conditions for 1939. In anticipation of an increased demand for its services the Lane-Wells Company will extend its operations to provide more comprehensive services in all fields of operations. Lane-Wells services now include gun-perforating, electrical logging, oriented and magnetic survey services and magnetic survey instruments, packers and liner hangers, bridging plugs and dual seal cementers.

Engineers Union Producing Company

Members of the engineering staff of the Union Producing Company, Vivian, Louisiana, are shown here. Reading from left to right they are: front row, W. D. Morris, assistant district engineer; B. M. Nowery, jr., petroleum engineer; C. M. Roberts, petroleum engineer; B. J. Dowd, district engineer and production superintendent; back row, E. E. Richards, petroleum engineer; F. E. Carmody, petroleum engineer; L. E. Bell, jr., petroleum engineer, and C. H. Clawson, assistant district engineer.

Fall Meetings A.I.M.M.E.

Fall meetings of the petroleum divisions of the American Institute of Mining and Metallurgical Engineers will be held at San Antonio, Texas, on October 5, 6, and 7, and at Los Angeles on October 20 and 21.

The tentative program for the San Antonio meeting is as follows: "Squeeze Cementing," by C. P. Parsons, Halliburton Oil Well Cementing Company; "Properties of Oil Well Cement," by Eugene L. Davis, The Texas Company; "A Method for Determining the Water Content of Sands," by H. G. Botset, Gulf Research and Development Company; "Core Analysis and Interpretation," by Howard Pyle and John Sherborne, Union Oil Company of California; "Core Analysis," by James A. Lewis, Core Laboratories, Inc.; "The Effect of Pressure Reduction on Core Saturation," by H. G. Botset and Morris Muskat, Gulf Research and Development Co.; "Electric Logging," by R. Roubidoux, Halliburton Oil Well Cementing Company; "An Apparatus for the Determination of Porosity by the Gas Expansion Method," by Albert B. Stevens, A. and M. College of Texas; "New Developments in the Chemical Treatment of Wells," by P. E. Fitzgerald, Dowell, Inc.; "Effect of Acid Treatment Upon Ultimate Recovery from Some Limestone Fields in Kansas," by R. E. Heithecker, U. S. Bureau of Mines; "The Surface Chemistry of Clays and Shales," by Allen D. Garrison, The Rice Institute; "The Viscosity Characteristics of Clays," by G. Broughton and R. S. Hand, Massachusetts Institute of Technology; "Surface and Interfacial Tensions of Oil-water Systems in Texas Oil Sands," H. K. Livingston, Shell Research Fellow, The University of Texas; "Flow of Oil-water Mixtures Through Unconsolidated Sands," by M. C. Leverett, Massachusetts Institute of Technology; "The Interfacial Tension Between Reservoir Oil and Water," by Claude R. Hocott, Humble Oil and Refining Company; "A Visual Study of the Flow of Air-water Mixtures in a Vertical Pipe," by R. L. Huntington and Sylvan Cromer, University of Oklahoma; "Significance of the Critical Phenomena in Oil and Gas Production," by D. L. Katz and C. C. Singleterry, University of Michigan; "Hydrocarbons," by W. K. Lewis, Massachusetts Institute of Technology; "Fluid Level Determination with the Echometer," by J. J. Jakosky, International Geophysics, Inc.; "The Application of Gravel-packing to Oil Wells in California," by E. L. Davis and W. A. Clark, The Texas Company; "Economics of Repressuring," R. J. Schilthuis, Humble Oil and Refining Company; "The Development of Decline Curve Analysis by the Valuation Classes at the University of Oklahoma," by H. E. Gross, University of Oklahoma; and "Geophysical Possibilities and Soil Analysis," by Mitchell Tucker, Geological Scientific Service Company.

The program of the Petroleum Division at Los Angeles tentatively is as follows: "Interpretation of Deeply Buried Structures: Geophysical, Geological," by Walter English, W.S.W. Kew, and others; "Theoretical Reservoir Conditions: Physical Relationship of Oil and Gas," by John F. Dodge; "A Suggested Cause and Measure of Retrograde Condensation and Retrograde Vaporization," by W. H. Geis; "Field Development and Field Operations," by Stanley Herold; "Modern Trends in Drilling Equipment," by A. H. Bell and others; "Current Trends in Drilling Practices," by A. S. Hayes and others; "A Resume of the Technique and Economics of Coring," by Sam Grinsfelder; "Core Analysis," by Howard C. Pyle and John E. Sherborne; "Formation Tests," by D. T. Hoenshell; "Casing and Cementing: Requirements of the California State Division of Oil and Gas," by E. Huguenin; "Casing Trends," by N. W. Wickersham and Mr. Fromme; "Cementing," by E. L. Davis; "Production Equipment," by C. A. Yeatman; and "Completion Methods," by W. Clarke.

What is YOUR *pumping problem?*

Corrosion?
Sand?
Lodestone?
Magnetic Trouble?
Ball Breakage?

Whatever it is, there is a

B-M-W Ball & Seat

that will take care of it, whether the load be light, medium or heavy. Our experience in the manufacture and application of balls and seats has been exceptionally broad. We shall be glad to help you with your problems. For instance:

CHROMARD, made of stainless steel, is perhaps the most widely used Ball and Seat in the U. S., and possibly the world;
MONARCH is of hardest non-corrosive metal;
BRAMO is made of alloy steel;
LUMONEL is a monel alloy;
BI-METAL has a very hard bronze ball and a stainless steel seat;
EXTRARD BRONZE is a very hard bronze alloy.

THESE BALLS AND SEATS

and other B-M-W products can be bought at supply stores, including: ● ADMORE Insert Pump Anchors; ● NEILSON Tools (Safety Sucker Rod Hooks, Tubing Hooks, Rod Elevators, Sucker Rod Sockets, etc.); ● ADMORE Liner Barrels; ● TEX TYPE Plunger Fittings and Valves, and ● COLLINS Belt Clamps.

BRADFORD MOTOR WORKS INC.
OIL WELL SUPPLIES
BRADFORD, PA. — TULSA, OKLA.

Here...
Oakite Cleaning
SALVAGED
4,000 Bolts and Nuts a Day!

A tank manufacturer had a large accumulation of bolts and nuts from dismantled storage tanks.

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MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

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The Drop-Forged and "Combination" Pipe Cutters can be used as a 1- or 3-wheel cutter. All are improved cutters, accurately made with hardened steel pins and rollers. Thrust rods of "Saunders" type cutter are hardened at the point and bear on embedded, hardened steel block. On "Barnes Type" the thrust is taken up by drop-forged steel section. Parts are interchangeable with other standard makes. All are Cadmium Plated.

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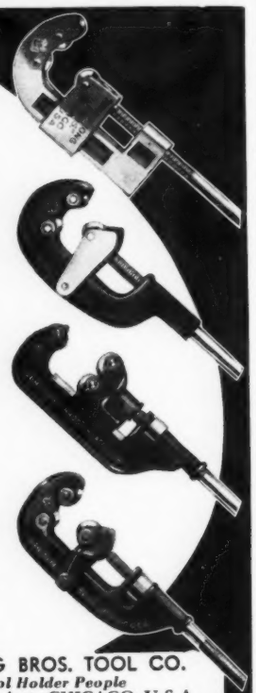

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Spring-Type
REGULATOR

EASILY transported, easily installed, self-protecting against accident or meddlers, you'll often find the Fulton Spring-Type Regulator preferable to one of the lever type for use in exposed, out-of-the-way places. Designed for high-pressure service as here shown, reduces from 300 pounds to any pressure between 10 and 50 pounds. Designed for low-pressure service, reduces inlet pressures as high as 50 pounds to outlet pressures of one pound or under. Full information given in Bulletin 118, mailed on request.

THE CHAPLIN-FULTON MFG. CO.

28-40 Penn Ave. **Pittsburgh, Pa.**

Leo Towers With Diesel Power Co.

Leo H. Towers, who has been executive secretary of the Tulsa Executives Association, and prior to that was at various times affiliated with the petroleum industry as a pipe line engineer and petroleum engineer, has accepted a position as engineer with The Diesel Power Company, Tulsa, Oklahoma.

LEO H. TOWERS

Dowell Opens New Offices

After four years of operation in the Rocky Mountain district with headquarters at Shelby, Montana, Dowell Incorporated, is opening two offices to keep pace with expanding field operations.

L. R. Austin is opening an office at Casper, Wyoming. Year 'round service will be maintained from the Cody station. A secondary station at Douglas, Wyoming, will service needs in eastern Wyoming and northern Colorado.

W. B. Tennis is opening a new office for Dowell in Calgary. Field operations will be continued from Okotoks as in the past to insure prompt and efficient service.

Allis-Chalmers Dallas Office Moved

The Dallas, Texas, district office of Allis-Chalmers Manufacturing Company, of which E. W. Burbank is manager, has been moved to a new location, 1800 North Market Street, where the power, electrical, and industrial divisions of the company now occupy an entire building. This three-story building houses not only the company's offices but also its warehouse.

M. O. Johnston Acquires Control Gas Lift Corporation

M. O. Johnston has recently taken over a controlling interest in, and the management of, the Gas Lift Corporation, Dallas, Texas. It is contemplated that the headquarters of the corporation will be moved to Houston, Texas, in the near future. There will be no change in the active personnel of the Gas Lift Corporation.

W. F. Hosler Passes Away

W. F. Hosler, chairman of the board of directors and former president of The Buckeye Traction Ditcher Company, Findlay, Ohio, died at his home in Findlay on August 20, 1938, at the age of 78.

As a member of the board of directors and as president of the company since 1913, Hosler was long active in the affairs of his company. In January, 1937, he was elected chairman of the board of directors. Though confined to his home for about a year prior to his death, Hosler continued active participation in industrial and civic affairs.

Johnston Oil Field Service in New Building

The Johnston Oil Field Service Corporation has completed its new building at 5702 Navigation Boulevard, Houston, Texas, and has transferred to that address from quarters in the M. & M. Building, its formation and water shut-off testing operations.

Book Reviews

Proceedings of the Petroleum Fluid Metering Conference, sponsored by the Petroleum Division of the American Society of Mechanical Engineers and the College of Engineering of the University of Oklahoma. 78 pp., 1938. Price, $1.50. (Obtainable from W. H. Carson, University of Oklahoma, Norman, Oklahoma.)

This volume includes in full the papers presented at the conference, and the discussion of the papers. The subjects include the fundamental principles of the various types of meters and the use of meters in the producing, transporting, and refining divisions of the oil industry. The work is therefore a fairly comprehensive review of the theory of fluid measurement by meters, the present refinements and limitations of the instruments, and the probable future attainments in the development of meters for measuring oil and refined products.

* * *

Molybdenum in Steel, published by Climax Molybdenum Company, 500 Fifth Ave., New York, 1938. 127 pp. (loose leaf).

In the introductory chapter are given the general effects of the addition of molybdenum to steel. Each of the other twelve chapters includes data and diagrams pertaining to the effect of molybdenum on a particular group of alloys, type of steel, or specific property of steel. Numerous analyses and tables of physical properties are included, and the common uses of many of the steels are listed. A general index is included.

Macwhyte to Open San Francisco Warehouse

The Macwhyte Company, Kenosha, Wisconsin, has opened a new San Francisco warehouse at 749 Bryant Street (phone Exbrook 4966), where a complete stock of wire rope, including elevator cable, is carried for supplying customers in the San Francisco territory.

Fred M. Sime, formerly with Hazard Wire Rope Company, has been appointed sales manager for central and northern California, and for eastern Nevada.

Union Wire Rope Opens Houston Branch

The Union Wire Rope Corporation, Kansas City, Missouri, announces the opening of a new branch in Houston, Texas. The warehouse, at 5805 Navigation Boulevard, is rapidly being stocked with a complete line of wire ropes for all purposes, and will serve the distributors and customers of the corporation in the Gulf Coast area of Texas, Louisiana, Mississippi, and Alabama, as well as customers in Mexico and South America. H. E. Frye has been appointed Gulf Coast manager and has been transferred from Portland, Oregon, to Houston.

The present warehouse is a temporary location until time permits the completion of a new warehouse building, which will be erected on a site already selected. The distributor of Union Wire lines in the Houston area is Plowden Supply Company, 2300 Navigation Boulevard.

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GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today!
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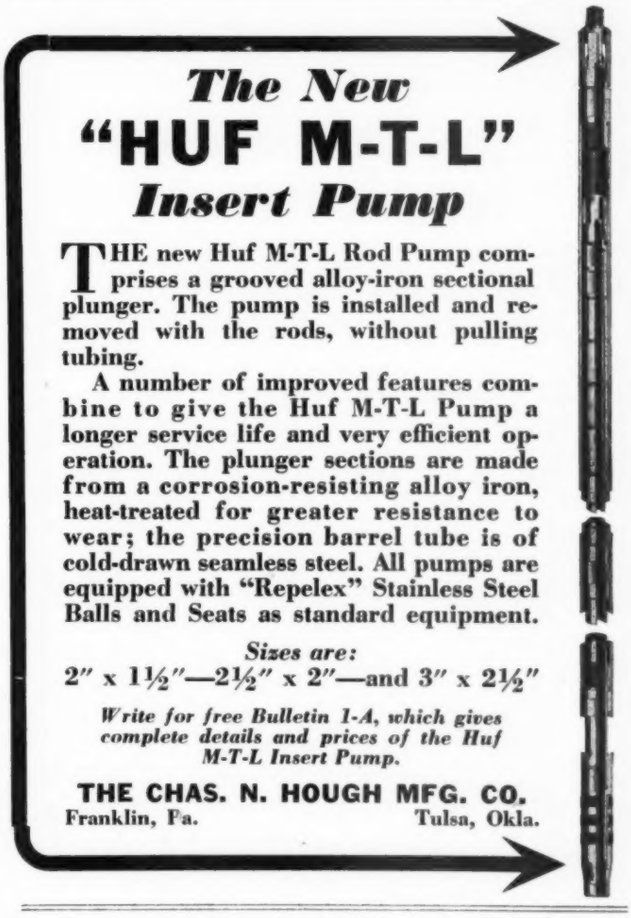
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"HUF M-T-L"
Insert Pump
THE new Huf M-T-L Rod Pump comprises a grooved alloy-iron sectional plunger. The pump is installed and removed with the rods, without pulling tubing.
A number of improved features combine to give the Huf M-T-L Pump a longer service life and very efficient operation. The plunger sections are made from a corrosion-resisting alloy iron, heat-treated for greater resistance to wear; the precision barrel tube is of cold-drawn seamless steel. All pumps are equipped with "Repelex" Stainless Steel Balls and Seats as standard equipment.
Sizes are:
2" x 1½"—2½" x 2"—and 3" x 2½"
Write for free Bulletin 1-A, which gives complete details and prices of the Huf M-T-L Insert Pump.
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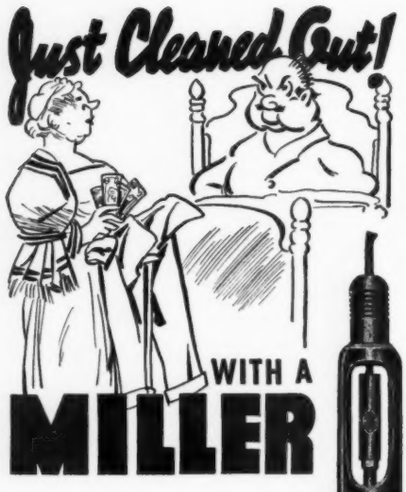

With the sand removed, production is increased—that's why the MILLER is bringing in more oil dollars throughout the world.

The MILLER is made in diameters of 2½, 3, 3½, 4, 4¼, 5, 5½, 7 and 9 inches and lengths of 20, 25 and 30 feet. 5/32-inch wall thickness in REGULAR Type, ¼-inch wall tubes HEAVY Type Sand Pumps.

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To Meet Every Condition

- **BAILER BOTTOM**
  With the Bailer Bottom installed the MILLER is quickly changed to a Bailer giving you a combination of either Bailer or a Sand Pump in one tool.
- **SAND BOTTOM**
  Used when tools are run and when well is shot to quickly remove loose material.
- **STAR BOTTOM**
  Used for cutting the sand loose.
- **CHISEL BOTTOM**
  (In Pump)
  With this bottom tightly packed sand can be easily broken in small pieces so it can be picked up in the pump.

Write for Descriptive Folder and Price List

See Page 1445 COMPOSITE CATALOG

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A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 16

IN presenting data in tabular form it is necessary to estimate the practical limits of each variable. For maximum utility, the data in any table must cover this entire range. The chosen limits, together with the amount of space available, will determine the interval between values of the independent variables. The space allotted to each variable may be adjusted and is governed by certain limiting details in arranging and setting-up the tables. Even after arranging these details carefully it is not always possible to include every value of each variable. The nearest value given in these tables, however, usually will be close enough for practical needs; if necessary, a still closer value may be found by interpolation. Although interpolation is a familiar process to anyone using tables frequently, its limitations are not so well known. A brief explanation of interpolation will be given with Installment No. 17.

Engineering Data Especially Compiled for Office, Field, and Plant Use

A REGULAR FEATURE OF THE PETROLEUM ENGINEER

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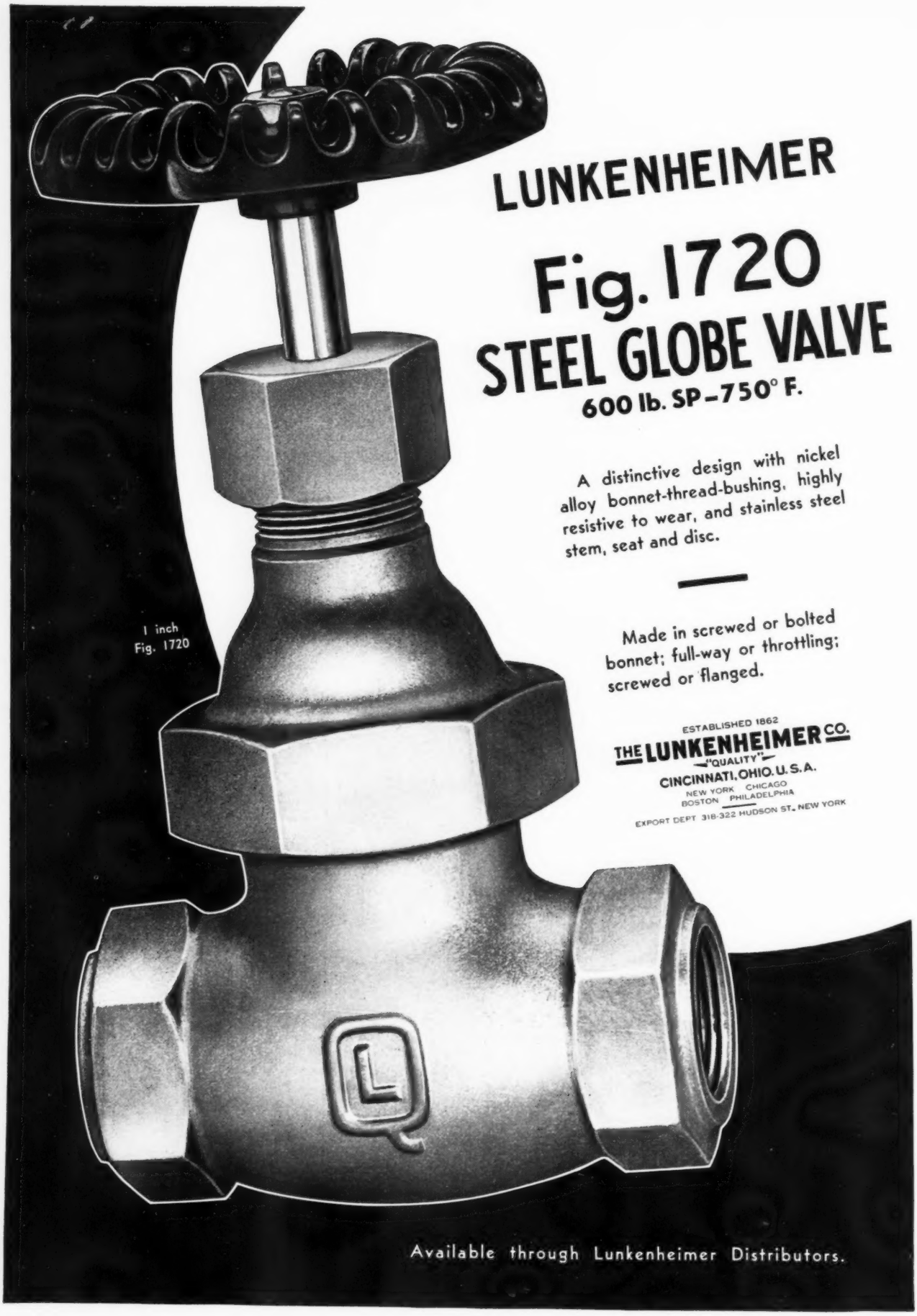
SPECIFIC GRAVITY OF SULPHURIC ACID SOLUTIONS AT VARIOUS TEMPERATURES

Weight percent of H_2SO_4	Temperature of solution										
	0° C 32° F	10° C 50° F	15° C 59° F	20° C 68° F	25° C 77° F	30° C 86° F	40° C 104° F	50° C 122° F	60° C 140° F	80° C 176° F	100 °C 212° F
51	1.4209	1.4128	1.4088	1.4049	1.4009	1.3970	1.3893	1.3816	1.3740	1.3590	1.3444
52	1.4310	1.4228	1.4188	1.4148	1.4109	1.4069	1.3991	1.3914	1.3837	1.3687	1.3540
53	1.4412	1.4329	1.4289	1.4248	1.4209	1.4169	1.4091	1.4013	1.3936	1.3785	1.3637
54	1.4515	1.4431	1.4391	1.4350	1.4310	1.4270	1.4191	1.4113	1.4036	1.3884	1.3735
55	1.4619	1.4535	1.4494	1.4453	1.4412	1.4372	1.4293	1.4214	1.4137	1.3984	1.3834
56	1.4724	1.4640	1.4598	1.4557	1.4516	1.4475	1.4396	1.4317	1.4239	1.4085	1.3934
57	1.4830	1.4746	1.4703	1.4662	1.4621	1.4580	1.4500	1.4420	1.4342	1.4187	1.4035
58	1.4937	1.4852	1.4809	1.4768	1.4726	1.4685	1.4604	1.4524	1.4446	1.4290	1.4137
59	1.5045	1.4959	1.4916	1.4875	1.4832	1.4791	1.4703	1.4629	1.4551	1.4393	1.4240
60	1.5154	1.5067	1.5024	1.4983	1.4940	1.4898	1.4816	1.4735	1.4656	1.4497	1.4344
61	1.5264	1.5177	1.5133	1.5091	1.5048	1.5006	1.4923	1.4842	1.4762	1.4602	1.4449
62	1.5375	1.5287	1.5243	1.5200	1.5157	1.5115	1.5031	1.4950	1.4869	1.4708	1.4554
63	1.5487	1.5398	1.5354	1.5310	1.5267	1.5225	1.5140	1.5058	1.4977	1.4815	1.4660
64	1.5600	1.5510	1.5465	1.5421	1.5378	1.5335	1.5250	1.5167	1.5086	1.4923	1.4766
65	1.5714	1.5623	1.5578	1.5533	1.5490	1.5446	1.5361	1.5277	1.5195	1.5031	1.4873
66	1.5828	1.5736	1.5691	1.5646	1.5602	1.5558	1.5472	1.5388	1.5305	1.5140	1.4981
67	1.5943	1.5850	1.5805	1.5760	1.5715	1.5671	1.5584	1.5499	1.5416	1.5249	1.5089
68	1.6059	1.5965	1.5920	1.5874	1.5829	1 5785	1.5697	1.5611	1.5528	1.5359	1.5198
69	1.6176	1.6081	1.6035	1.5989	1.5944	1.5899	1.5811	1.5724	1.5640	1.5470	1.5307
70	1.6293	1.6198	1.6151	1.6105	1.6059	1.6014	1.5925	1.5838	1.5753	1.5582	1.5417
71	1.6411	1.6315	1.6268	1.6221	1.6175	1.6130	1.6040	1.5952	1.5867	1.5694	1.5527
72	1.6529	1.6433	1.6385	1.6338	1.6292	1.6246	1.6155	1.6067	1.5981	1.5806	1.5637
73	1.6648	1.6551	1.6503	1.6456	1.6409	1.6363	1.6271	1.6182	1.6095	1.5919	1.5747
74	1.6768	1.6670	1.6622	1.6574	1.6526	1.6480	1.6387	1.6297	1.6209	1.6031	1.5857
75	1.6888	1.6789	1.6740	1.6692	1.6644	1.6597	1.6503	1.6412	1.6322	1.6142	1.5966
76	1.7008	1.6908	1.6858	1.6810	1.6761	1.6713	1.6619	1.6526	1.6435	1.6252	1.6074
77	1.7128	1.7026	1.6976	1.6927	1.6878	1.6829	1.6734	1.6640	1.6547	1.6361	1.6181
78	1.7247	1.7144	1.7093	1.7043	1.6994	1.6944	1.6847	1.6751	1.6657	1.6469	1.6286
79	1.7365	1.7261	1.7209	1.7158	1.7108	1.7058	1.6959	1.6862	1.6766	1.6575	1.6390
80	1.7482	1.7376	1.7323	1.7272	1.7221	1.7170	1.7069	1.6971	1.6873	1.6680	1.6493
81	1.7597	1.7489	1.7435	1.7383	1.7331	1.7279	1.7177	1.7077	1.6978	1.6782	1.6594
82	1.7709	1.7599	1.7544	1.7491	1.7437	1.7385	1.7281	1.7180	1.7080	1.6882	1.6692
83	1.7815	1.7704	1.7649	1.7594	1.7540	1.7487	1.7382	1.7279	1.7179	1.6979	1.6787
84	1.7916	1.7804	1.7748	1.7693	1.7639	1.7585	1.7479	1.7375	1.7274	1.7072	1.6878
85	1.8009	1.7897	1.7841	1.7786	1.7732	1.7678	1.7571	1.7466	1.7364	1.7161	1.6966
86	1.8095	1.7983	1.7927	1.7872	1.7818	1.7763	1.7657	1.7552	1.7449	1.7245	1.7050
87	1.8173	1.8061	1.8006	1.7951	1.7897	1.7842	1.7736	1.7632	1.7529	1.7324	1.7129
88	1.8243	1.8132	1.8077	1.8022	1.7968	1.7914	1.7809	1.7705	1.7602	1.7397	1.7202
89	1.8306	1.8195	1.8141	1.8087	1.8033	1.7979	1.7874	1.7770	1.7669	1.7464	1.7269
90	1.8361	1.8252	1.8198	1.8144	1.8091	1.8038	1.7933	1.7829	1.7729	1.7525	1.7331
91	1.8410	1.8302	1.8248	1.8195	1.8142	1.8090	1.7986	1.7883	1.7783	1.7581	1.7388
92	1.8453	1.8346	1.8293	1.8240	1.8188	1.8136	1.8033	1.7932	1.7832	1.7633	1.7439
93	1.8490	1.8384	1.8331	1.8279	1.8227	1.8176	1.8074	1.7974	1.7876	1.7681	1.7485
94	1.8520	1.8415	1.8363	1.8312	1.8260	1.8210	1.8109	1.8011	1.7914		
95	1.8544	1.8439	1.8388	1.8337	1.8286	1.8236	1.8137	1.8040	1.7944		
96	1.8560	1.8457	1.8406	1.8355	1.8305	1.8255	1.8157	1.8060	1.7965		
97	1.8569	1.8466	1.8414	1.8364	1.8314	1.8264	1.8166	1.8071	1.7977		
98	1.8567	1.8463	1.8411	1.8361	1.8310	1.8261	1.8163	1.8068	1.7976		
99	1.8551	1.8445	1.8393	1.8342	1.8292	1.8242	1.8145	1.8050	1.7958		
100	1.8517	1.8409	1.8357	1.8305	1.8255	1.8205	1.8107	1.8013	1.7922		


LUNKENHEIMER
Fig. 1720
STEEL GLOBE VALVE
600 lb. SP–750° F.
A distinctive design with nickel alloy bonnet-thread-bushing, highly resistive to wear, and stainless steel stem, seat and disc.
Made in screwed or bolted bonnet; full-way or throttling; screwed or flanged.
1 inch
Fig. 1720
ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
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EXPORT DEPT. 318-322 HUDSON ST., NEW YORK
Q
Available through Lunkenheimer Distributors.

ENERGY REQUIRED TO LIFT FLUID, THOUSAND FT.-LB. PER 42-GAL. BBL.

Height of lift, ft.	Sp. gr. of fluid heavier than water				Fresh water (sp. gr. = 1) (A.P.I. gr. = 10)	Gravity of fluid lighter than water, deg. A.P.I.											
	1.16	1.12	1.08	1.04		12	16	20	24	28	32	36	40	44	48		
5100	2068.7	1997.4	1926.0	1854.7	1783.4	1761.1	1713.2	1667.9	1625.0	1584.2	1545.5	1508.7	1473.7	1439.9	1407.7		
5200	2109.2	2036.5	1963.8	1891.0	1818.3	1795.6	1746.8	1700.6	1656.9	1615.3	1575.8	1538.3	1502.6	1468.1	1435.3		
5300	2149.8	2075.7	2001.5	1927.4	1853.3	1830.1	1780.4	1733.3	1688.7	1646.3	1606.1	1567.9	1531.5	1496.3	1462.9		
5400	2190.3	2114.9	2039.3	1963.8	1888.3	1864.7	1847.6	1798.7	1752.5	1708.5	1666.7	1627.1	1589.3	1552.8	1518.1		
5500	2230.9	2154.0	2077.1	2000.1	1923.2	1899.2	1881.2	1831.4	1784.3	1739.5	1697.0	1656.6	1618.2	1581.0	1545.7		
5600	2271.5	2193.2	2114.8	2036.5	1958.2	1933.7	1914.8	1864.1	1816.2	1770.6	1727.3	1686.2	1647.1	1609.3	1573.3		
5700	2312.0	2232.3	2152.6	2072.9	1993.2	1968.3	1948.4	1896.8	1848.1	1801.7	1757.6	1715.8	1676.0	1637.5	1600.9		
5800	2352.6	2271.5	2190.4	2109.2	2028.1	2002.8	1982.0	1929.5	1879.9	1832.7	1787.9	1745.4	1704.9	1665.7	1628.5		
5900	2393.2	2310.7	2228.1	2145.6	2063.1	2037.3	2015.6	1962.2	1911.8	1863.8	1818.2	1775.0	1733.8	1694.0	1656.1		
6000	2433.7	2349.8	2265.9	2182.0	2098.1	2071.9	2049.2	1994.9	1943.6	1894.8	1848.5	1804.6	1762.7	1722.2	1683.7		
6100	2474.3	2389.0	2303.7	2218.3	2133.0	2106.4	2082.8	2027.6	1975.5	1925.9	1878.8	1834.1	1791.6	1750.4	1711.3		
6200	2514.8	2428.2	2341.4	2254.7	2168.0	2140.9	2116.4	2060.4	2007.4	1957.0	1909.1	1863.7	1820.4	1778.7	1738.9		
6300	2555.4	2467.3	2379.2	2291.1	2203.0	2175.5	2150.0	2093.1	2039.2	1988.0	1939.4	1893.3	1849.3	1806.9	1766.5		
6400	2596.0	2506.5	2417.0	2327.4	2238.0	2210.0	2183.5	2125.8	2071.1	2019.1	1969.7	1922.9	1878.2	1835.1	1794.1		
6500	2636.5	2545.7	2454.7	2363.8	2272.9	2244.5	2217.1	2158.5	2103.0	2050.2	2000.0	1952.5	1907.1	1863.4	1821.7		
6600	2677.1	2584.8	2492.5	2400.2	2307.9	2279.0	2250.7	2191.2	2134.8	2081.2	2030.3	1982.1	1936.0	1891.6	1849.3		
6700	2717.7	2624.0	2530.3	2436.5	2342.9	2313.6	2284.3	2223.9	2166.7	2112.3	2060.6	2011.6	1964.9	1919.8	1876.9		
6800	2758.2	2663.2	2568.0	2472.9	2377.8	2348.1	2317.9	2256.6	2198.5	2143.3	2090.9	2041.2	1993.8	1948.1	1904.5		
6900	2798.8	2702.3	2605.8	2509.3	2412.8	2382.6	2351.5	2289.3	2230.4	2174.4	2121.2	2070.8	2022.7	1976.3	1932.1		
7000	2839.3	2741.5	2643.6	2545.6	2447.8	2417.2	2385.1	2322.0	2262.3	2205.5	2151.5	2100.4	2051.6	2004.5	1959.7		
7100	2879.9	2780.6	2681.3	2582.0	2482.7	2451.7	2418.7	2354.7	2294.1	2236.5	2181.8	2130.0	2080.5	2032.8	1987.3		
7200	2920.5	2819.8	2719.1	2618.4	2517.7	2486.2	2452.3	2387.4	2326.0	2267.6	2212.1	2159.6	2109.4	2061.0	2014.9		
7300	2961.0	2859.0	2756.8	2654.7	2552.7	2520.8	2485.9	2420.1	2357.9	2298.7	2242.4	2189.1	2138.3	2089.2	2042.5		
7400	3001.6	2898.1	2794.6	2691.1	2587.6	2555.3	2519.5	2452.8	2389.7	2329.7	2272.7	2218.7	2167.2	2117.5	2070.2		
7500	3042.2	2937.3	2832.4	2727.4	2622.6	2589.8	2553.1	2485.5	2421.6	2360.8	2303.0	2248.3	2196.1	2145.7	2097.8		
7600	3082.7	2976.5	2870.1	2763.8	2657.6	2624.4	2586.7	2518.2	2453.5	2391.9	2333.3	2277.9	2225.0	2173.9	2125.4		
7700	3123.3	3015.6	2907.9	2800.2	2692.5	2658.9	2620.3	2550.9	2485.3	2422.9	2363.6	2307.5	2253.9	2202.2	2153.0		
7800	3163.8	3054.8	2945.7	2836.5	2727.5	2693.4	2653.8	2583.6	2517.2	2454.0	2393.9	2337.1	2282.8	2230.4	2180.6		
7900	3204.4	3094.0	2983.4	2872.9	2762.5	2727.9	2687.4	2616.3	2549.0	2485.0	2424.2	2366.6	2311.7	2258.6	2208.2		
8000	3245.0	3133.1	3021.2	2909.3	2797.4	2762.5	2721.0	2649.0	2580.9	2516.1	2454.5	2396.2	2340.6	2286.9	2235.8		
8100	3285.5	3172.3	3059.0	2945.6	2832.4	2797.0	2754.6	2681.7	2612.8	2547.2	2484.8	2425.8	2369.5	2315.1	2263.4		
8200	3326.1	3211.4	3096.7	2982.0	2867.4	2831.5	2788.2	2714.4	2644.6	2578.2	2515.1	2455.4	2398.4	2343.3	2291.0		
8300	3366.6	3250.6	3134.5	3018.4	2902.3	2866.1	2821.8	2747.1	2676.5	2609.3	2545.5	2485.0	2427.3	2371.6	2318.6		
8400	3407.2	3289.8	3172.3	3054.7	2937.3	2900.6	2855.4	2779.8	2708.4	2640.4	2575.8	2514.6	2456.2	2399.8	2346.2		
8500	3447.8	3328.9	3210.0	3091.1	2972.3	2935.1	2889.0	2812.5	2740.2	2671.4	2606.1	2544.1	2485.1	2428.0	2373.8		
8600	3488.3	3368.1	3247.8	3127.5	3007.2	2969.7	2922.6	2845.2	2772.1	2702.5	2636.4	2573.7	2514.0	2456.3	2401.4		
8700	3528.9	3407.3	3285.6	3163.8	3042.2	3004.2	2956.2	2878.0	2803.9	2733.5	2666.7	2603.3	2542.8	2484.5	2429.0		
8800	3569.5	3446.4	3323.3	3200.2	3077.2	3038.7	2989.8	2910.7	2835.8	2764.6	2697.0	2632.9	2571.7	2512.7	2456.6		
8900	3610.0	3485.6	3361.1	3236.6	3112.2	3073.3	3023.4	2943.4	2867.7	2795.7	2727.3	2662.5	2600.6	2541.0	2484.2		
9000	3650.6	3524.8	3398.9	3272.9	3147.1	3107.8	3057.0	2976.1	2899.5	2826.7	2757.6	2692.1	2629.5	2569.2	2511.8		
9100	3691.1	3563.9	3436.6	3309.3	3182.1	3142.3	3090.6	3008.8	2931.4	2857.8	2787.9	2721.6	2658.4	2597.4	2539.4		
9200	3731.7	3603.1	3474.4	3345.7	3217.1	3176.9	3124.1	3041.5	2963.3	2888.9	2818.2	2751.2	2687.3	2625.7	2567.0		
9300	3772.3	3642.3	3512.1	3382.0	3252.0	3211.4	3157.7	3074.2	2995.1	2919.9	2848.5	2780.8	2716.2	2653.9	2594.6		
9400	3812.8	3681.4	3549.9	3418.4	3287.0	3245.9	3191.3	3106.9	3027.0	2951.0	2878.8	2810.4	2745.1	2682.1	2622.2		
9500	3853.4	3720.6	3587.7	3454.8	3322.0	3280.4	3224.9	3139.6	3058.8	2982.0	2909.1	2840.0	2774.0	2710.4	2649.8		
9600	3894.0	3759.7	3625.4	3491.1	3356.9	3315.0	3258.5	3172.3	3090.7	3013.1	2939.4	2869.6	2802.9	2738.6	2677.4		
9700	3934.5	3798.9	3663.2	3527.5	3391.9	3349.5	3292.1	3205.0	3122.6	3044.2	2969.7	2899.1	2831.8	2766.8	2705.0		
9800	3975.1	3838.1	3701.0	3563.9	3426.9	3384.0	3325.7	3237.7	3154.4	3075.2	3000.0	2928.7	2860.7	2795.1	2732.6		
9900	4015.6	3877.2	3738.7	3600.2	3461.8	3418.6	3359.3	3270.4	3186.3	3106.3	3030.3	2958.3	2889.6	2823.3	2760.2		
10000	4056.2	3916.4	3776.5	3636.6	3496.8	3453.1											

FOR SOUR WELLS

Sucker-rod trouble in sour wells is a headache for everybody. Wastes time, money and work.

Nickel-Moly (S.A.E. 4620) steel sucker rods are an excellent remedy for rod trouble in sour wells. They are uniformly strong and tough; have good fatigue-strength; good resistance to corrosion fatigue.

They assure a steady flow from the well at a reduced expense for replacements and labor. Consequently, their use is increasing rapidly.

In fact, Molybdenum steels are cutting operating costs and increasing equipment efficiency everywhere in oil fields. Practical data are contained in our book, "Molybdenum in Steel." It will be sent on request. Climax Molybdenum Co., 500 Fifth Ave., New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY

Climax Mo-lyb-den-um Company

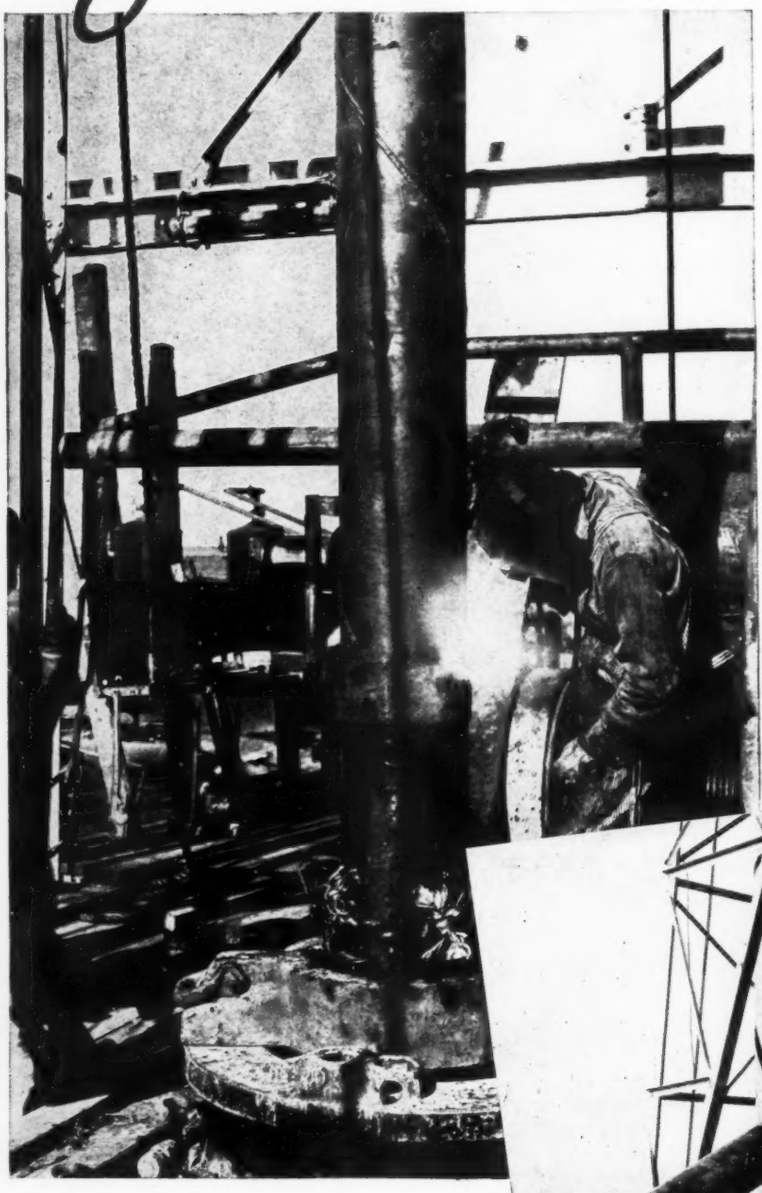
TOTAL[1] UPWARD PRESSURE AT WELL HEAD BETWEEN CASINGS OF VARIOUS SIZES, LB.

Diam. of larger casing, O.D., in.	Diam. of smaller casing, O.D., in.	Well head pressure, lb. per sq. in. gauge																	
		1000	2000	3000	3500	4000	4500	5000	5500	6000	6250	6500	6750	7000	7200	7400	7600	7800	8000
10	6	40,890	81,775	122,665	143,110	163,550	183,995	204,440	224,885	245,330	255,550	265,770	275,995	286,215	294,395	302,570	310,750	318,925	327,105
	6⅝	34,690	69,380	104,070	121,415	138,760	156,105	173,450	190,795	208,140	216,810	225,485	234,160	242,830	249,770	256,705	263,645	270,580	277,520
	7	30,675	61,355	92,030	107,370	122,710	138,045	153,385	168,725	184,060	191,730	199,400	207,070	214,740	220,875	227,010	233,145	239,280	245,415
	7⅝	23,500	46,995	70,495	82,245	93,990	105,740	117,490	129,240	140,990	146,860	152,735	158,610	164,485	169,185	173,885	178,585	183,285	187,985
	8	18,895	37,790	56,690	66,135	75,585	85,030	94,480	103,930	113,375	118,100	122,825	127,550	132,270	136,050	139,830	143,610	147,390	151,170
	8⅛	17,315	34,625	51,940	60,595	69,250	77,910	86,565	95,220	103,880	108,205	112,535	116,865	121,190	124,655	128,115	131,580	135,040	138,505
10¾	6	51,055	102,105	153,160	178,685	204,210	229,740	255,265	280,790	306,320	319,080	331,845	344,610	357,370	367,580	377,790	388,005	398,215	408,425
	6⅝	44,855	89,710	134,565	156,990	179,420	201,850	224,275	246,700	269,130	280,345	291,560	302,770	313,985	322,955	331,925	340,900	349,870	358,840
	7	40,840	81,685	122,525	142,945	163,370	183,790	204,210	224,630	245,050	255,260	265,475	275,685	285,895	294,060	302,230	310,400	318,570	326,735
	7⅝	33,665	67,325	100,990	117,820	134,650	151,485	168,315	185,145	201,980	210,395	218,810	227,225	235,640	242,375	249,105	255,840	262,570	269,305
	8	29,060	58,120	87,185	101,715	116,245	130,775	145,305	159,835	174,365	181,630	188,895	196,160	203,425	209,240	215,050	220,865	226,675	232,490
	8⅛	27,480	54,955	82,435	96,175	109,910	123,650	137,390	151,130	164,870	171,740	178,605	185,475	192,345	197,840	203,335	208,835	214,330	219,825
	8⅝	20,900	41,800	62,705	73,155	83,605	94,055	104,505	114,955	125,405	130,630	135,855	141,080	146,305	150,485	154,665	158,850	163,030	167,210
11¾	6	66,760	133,520	200,275	233,655	267,035	300,415	333,795	367,175	400,555	417,245	433,935	450,625	467,315	480,665	494,015	507,370	520,720	534,070
	6⅝	60,560	121,120	181,685	211,965	242,245	272,525	302,805	333,085	363,365	378,505	393,645	408,785	423,925	436,040	448,150	460,265	472,375	484,490
	7	56,550	113,095	169,645	197,920	226,190	254,465	282,740	311,015	339,290	353,425	367,560	381,700	395,835	407,145	418,455	429,765	441,075	452,385
	7⅝	49,370	98,740	148,105	172,790	197,475	222,160	246,845	271,530	296,215	308,555	320,900	333,240	345,585	355,455	365,330	375,205	385,080	394,950
	8	44,765	89,535	134,300	156,685	179,070	201,450	223,835	246,220	268,600	279,795	290,985	302,175	313,370	322,320	331,275	340,230	349,185	358,135
	8⅛	43,185	86,370	129,550	151,145	172,735	194,330	215,920	237,510	259,105	269,900	280,695	291,490	302,290	310,925	319,560	328,200	336,835	345,470
	8⅝	36,605	73,215	109,820	128,125	146,430	164,730	183,035	201,340	219,640	228,795	237,945	247,095	256,250	263,570	270,890	278,215	285,535	292,855
	9	31,415	62,830	94,250	109,955	125,665	141,370	157,080	172,790	188,495	196,350	204,205	212,060	219,910	226,195	232,480	238,760	245,045	251,330
	9⅝	22,275	44,545	66,820	77,955	89,090	100,230	111,365	122,500	133,640	139,205	144,775	150,345	155,910	160,365	164,820	169,275	173,730	178,185
12	6	73,510	147,020	220,530	257,285	294,040	330,795	367,550	404,305	441,060	459,440	477,815	496,190	514,570	529,270	543,975	558,675	573,380	588,080
	6⅝	67,310	134,625	201,935	235,590	269,250	302,905	336,560	370,215	403,870	420,700	437,530	454,355	471,185	484,645	498,110	511,570	525,035	538,495
	7	63,300	126,600	189,895	221,545	253,195	284,845	316,495	348,145	379,795	395,620	411,445	427,270	443,095	455,755	468,415	481,070	493,730	506,390
	7⅝	56,120	112,240	168,360	196,420	224,480	252,540	280,600	308,660	336,720	350,750	364,780	378,810	392,840	404,065	415,290	426,510	437,735	448,960
	8	51,520	103,035	154,555	180,315	206,070	231,830	257,590	283,350	309,110	321,990	334,865	347,745	360,625	370,930	381,235	391,535	401,840	412,145
	8⅛	49,935	99,870	149,805	174,770	199,740	224,710	249,675	274,640	299,610	312,095	324,580	337,060	349,545	359,530	369,520	379,505	389,495	399,480
	8⅝	43,360	86,715	130,075	151,755	173,430	195,110	216,790	238,470	260,150	270,990	281,825	292,665	303,505	312,180	320,850	329,520	338,190	346,865
	9	38,165	76,335	114,500	133,585	152,670	171,750	190,835	209,920	229,000	238,545	248,085	257,625	267,170	274,800	282,435	290,070	297,705	305,335
	9⅝	29,025	58,050	87,070	101,585	116,095	130,610	145,120	159,630	174,145	181,400	188,655	195,910	203,170	208,975	214,780	220,580	226,385	232,190
	10	23,245	46,490	69,730	81,355	92,975	104,600	116,220	127,840	139,465	145,275	151,085	156,895	162,710	167,355	172,005	176,655	181,305	185,950

The fact that total well head pressures for unit pressures as high as 8000 lb. per sq. in. are included in the table should not be interpreted as indicating that the casing will have sufficient bursting strength to withstand such pressure. For bursting strength of casing see Table P432.2, p. 257, August, 1937, issue.

[1]Total for lightest weight casing, hence a maximum for each size casing.

8 Minutes Per Joint ...AVERAGE RUNNING TIME!



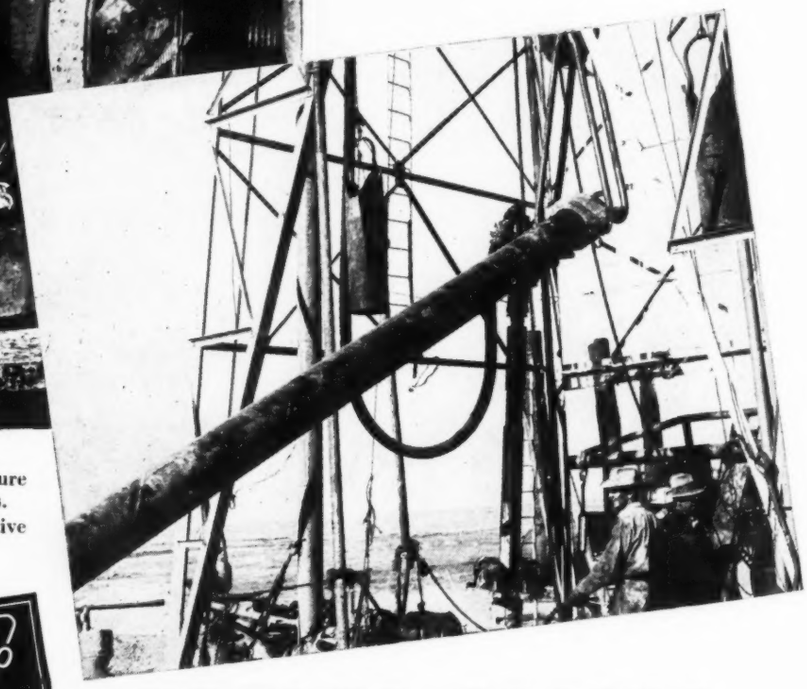
Here's real economy for you! Based on actual field studies, the average running time for Armco *Slip Joint* Surface Casing is about 8 minutes per joint with one welder. No special handling equipment or line-up clamps are necessary. And besides, you eliminate the extra cost of threaded ends and collars, which are of little value when the pipe is cemented in place.

For those who prefer threaded and coupled pipe, our distributor also stocks this type in uniform 30-foot joints. There is a diameter and wall thickness exactly suited to your requirements. Rapid delivery is assured. Just write, telephone or wire our distributor, or The American Rolling Mill Company, Pipe Sales Division, 1361 Curtis St., Middletown, Ohio.

Distributed by

NATIONAL TANK COMPANY

Tulsa, Oklahoma, and Branches



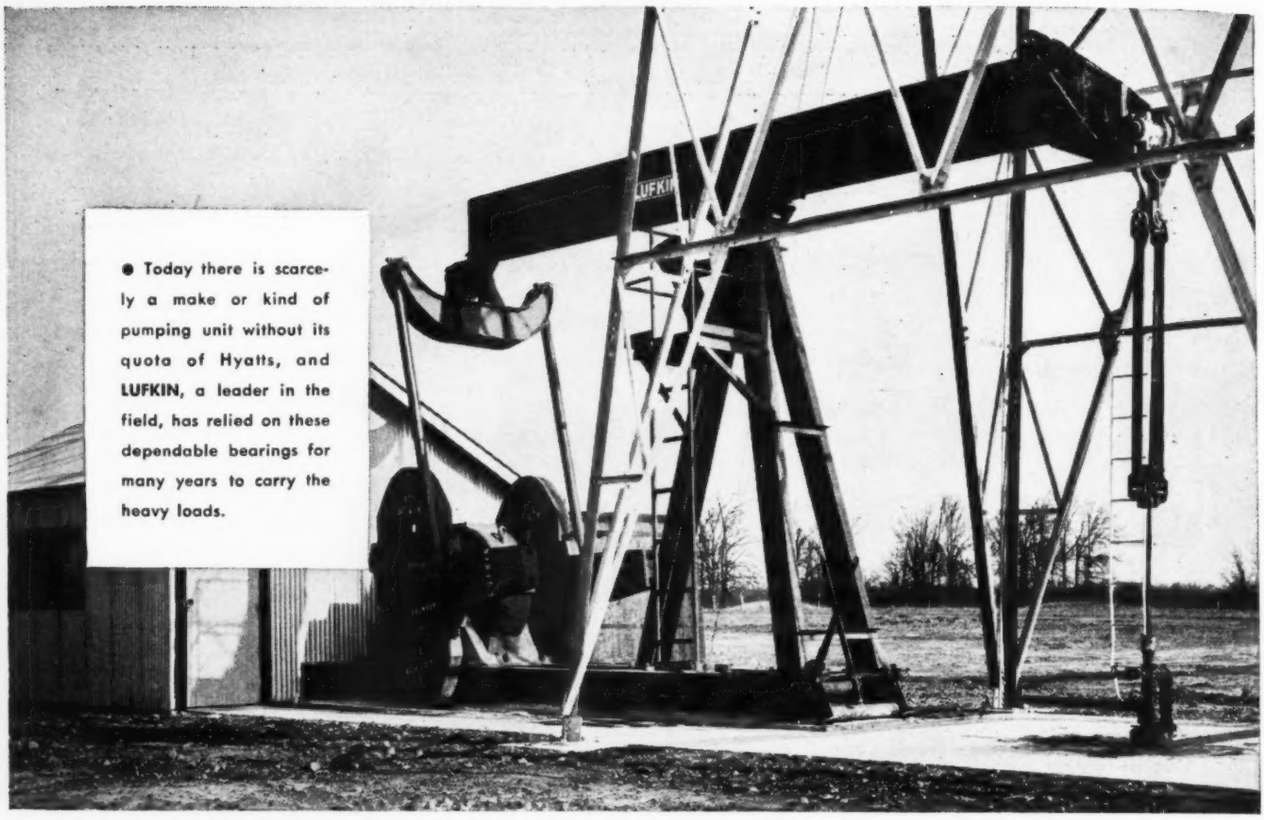
Above: Square ends of pipe in slip joint collar assure perfect alignment without use of line-up clamps. *Right:* With Armco Casing, no special expensive ends are needed on tongs, slips or elevators.

ARMCO ARMCO **SURFACE CASING**

VELOCITY[1] OF FLOW, FT. PER SEC., THROUGH 1¼-IN. TUBING

Rate of production, bbl. per day	Gas-oil ratio, cu.ft. per bbl.	Tubing pressure at casinghead, lb. per sq. in. gauge								
		0	25	50	75	100	125	150	175	200
50	1000	56.0	20.9	13.0	9.4	7.5	6.2	5.3	4.6	4.1
100		112.1	41.9	25.9	18.9	14.9	12.4	10.6	9.3	8.3
150		168.1	62.8	38.9	28.3	22.4	18.5	15.9	13.9	12.4
200		224.1	83.8	51.9	37.8	29.8	24.7	21.1	18.5	16.5
250		280.2	104.7	64.9	47.2	37.3	30.9	26.4	23.2	20.6
300		336.2	125.7	77.8	56.7	44.7	37.1	31.7	27.8	24.8
350		392.2	146.6	90.8	66.1	52.2	43.2	37.0	32.4	28.9
400		448.3	167.6	103.8	75.6	59.6	49.4	42.3	37.0	33.0
50	1250	70.0	26.1	16.1	11.7	9.2	7.6	6.5	5.7	5.1
100		139.9	52.2	32.3	23.5	18.5	15.3	13.1	11.4	10.2
150		209.9	78.3	48.4	35.2	27.7	22.9	19.6	17.1	15.2
200		279.8	104.4	64.5	46.9	37.0	30.6	26.1	22.8	20.3
250		349.8	130.5	80.7	58.6	46.2	38.2	32.6	28.6	25.4
300		419.8	156.6	96.8	70.4	55.4	45.8	39.2	34.3	30.5
350		489.7	182.7	113.0	82.1	64.7	53.5	45.7	40.0	35.6
400		559.7	208.8	129.1	93.8	73.9	61.1	52.2	45.7	40.7
50	1500	83.9	31.3	19.3	14.0	11.0	9.1	7.8	6.8	6.0
100		167.8	62.5	38.6	28.0	22.0	18.2	15.5	13.6	12.1
150		251.7	93.8	57.9	42.0	33.1	27.3	23.3	20.4	18.1
200		335.6	125.0	77.2	56.0	44.1	36.4	31.1	27.2	24.1
250		419.5	156.3	96.5	70.0	55.1	45.5	38.9	33.9	30.2
300		503.3	187.6	115.8	84.1	66.1	54.6	46.6	40.7	36.2
350		587.2	218.8	135.1	98.1	77.2	63.8	54.4	47.5	42.2
400		671.1	250.1	154.4	112.1	88.2	72.9	62.2	54.3	48.3
50	1750	97.8	36.4	22.5	16.3	12.8	10.6	9.0	7.9	7.0
100		195.6	72.8	44.9	32.6	25.6	21.1	18.0	15.7	14.0
150		293.5	109.3	67.4	48.9	38.4	31.7	27.0	23.6	21.0
200		391.3	145.7	89.9	65.2	51.2	42.3	36.1	31.5	28.0
250		489.1	182.1	112.3	81.5	64.0	52.9	45.1	39.3	34.9
300		586.9	218.5	134.8	97.8	76.9	63.4	54.1	47.2	41.9
350		684.7	254.9	157.3	114.0	89.7	74.0	63.1	55.1	48.9
400		782.6	291.3	179.7	130.3	102.5	84.6	72.1	63.0	55.9
50	2000	111.8	41.6	25.6	18.6	14.6	12.0	10.3	8.9	7.9
100		223.5	83.2	51.3	37.2	29.2	24.1	20.5	17.9	15.9
150		335.3	124.7	76.9	55.7	43.8	36.1	30.8	26.8	23.8
200		447.0	166.3	102.5	74.3	58.4	48.1	41.0	35.8	31.8
250		558.8	207.9	128.2	92.9	73.0	60.2	51.3	44.7	39.7
300		670.5	249.5	153.8	111.5	87.6	72.2	61.6	53.7	47.7
350		782.3	291.0	179.4	130.0	102.2	84.3	71.8	62.6	55.6
400		894.0	332.6	205.1	148.6	116.8	96.3	82.1	71.6	63.5
50	2250	125.7	46.7	28.8	20.9	16.4	13.5	11.5	10.0	8.9
100		251.4	93.5	57.6	41.7	32.8	27.0	23.0	20.1	17.8
150		377.0	140.2	86.4	62.6	49.1	40.5	34.5	30.1	26.7
200		502.7	186.9	115.2	83.4	65.5	54.0	46.0	40.1	35.6
250		628.4	233.7	144.0	104.3	81.9	67.5	57.5	50.1	44.5
300		754.1	280.4	172.8	125.1	98.3	81.0	69.0	60.2	53.4
350		879.8	327.1	201.6	146.0	114.7	94.5	80.5	70.2	62.3
400		1005.4	373.9	230.4	166.9	131.0	108.0	92.0	80.2	71.2
50	2500	139.6	51.9	32.0	23.1	18.2	15.0	12.7	11.1	9.9
100		279.2	103.8	63.9	46.3	36.3	29.9	25.5	22.2	19.7
150		418.8	155.7	95.9	69.4	54.5	44.9	38.2	33.3	29.6
200		558.4	207.6	127.8	92.6	72.7	59.9	51.0	44.4	39.4
250		698.1	259.5	159.8	115.7	90.8	74.9	63.7	55.5	49.3
300		837.7	311.3	191.8	138.8	109.0	89.8	76.5	66.6	59.1
350		977.3	363.2	223.7	162.0	127.2	104.8	89.2	77.8	69.0
400		1116.9	415.1	255.7	185.1	145.3	119.8	102.0	88.9	78.8

[1]Solution and condensation under pressure are not considered; hence the values are maxima.



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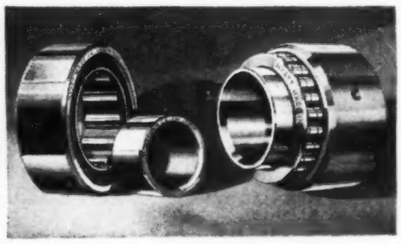
BECAUSE they run so smoothly for so many years in so many assignments, Hyatt Roller Bearings usually mean better designed, longer-lived, more dependable operating equipment. And one of the main reasons for the widespread use of Hyatts is their economical performance—economy that reaches right back to the source of power—because friction is practically eliminated, and wear is negligible. Built for endurance . . . for tough going . . . for heavy loads . . . Hyatt Roller Bearings withstand punishment that would make ordinary bearings old before their time. Designed right, built right, and applied right, Hyatts assure longer, economical operation wherever they serve. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT *Roller Bearings*

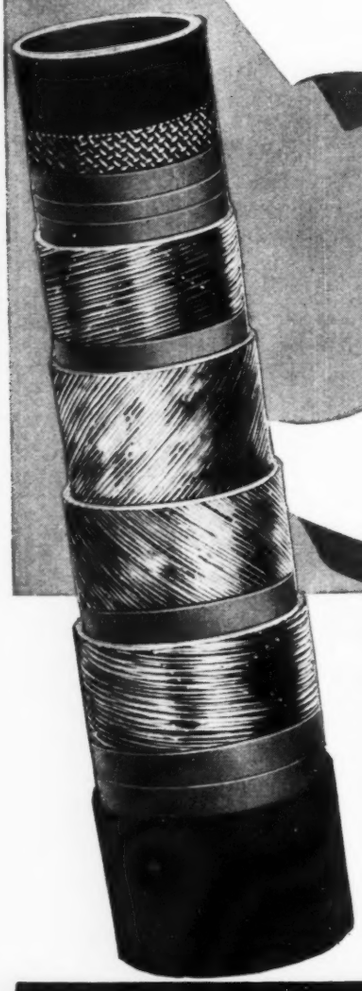


WEIGHT AND VOLUME OF 2⅜-IN. DRILL PIPE

Length of string of drill pipe, ft.	4.80 lb. drill pipe				6.65 lb. drill pipe			
	Weight, coupled,[1] lb.	Volume of fluid displaced, gal.	Weight of 9.5 lb./gal. fluid displaced, lb.	Net weight of drill pipe, lb.	Weight, coupled,[1] lb.	Volume of fluid displaced, gal.	Weight of 9.5 lb./gal. fluid displaced, lb.	Net weight of drill pipe, lb.
2,000	9,600	146.6	1,395	8,205	13,300	203.2	1,930	11,370
2,200	10,560	161.3	1,530	9,030	14,630	223.5	2,125	12,505
2,400	11,520	175.9	1,670	9,850	15,960	243.8	2,315	13,645
2,600	12,480	190.6	1,810	10,670	17,290	264.2	2,510	14,780
2,800	13,440	205.2	1,950	11,490	18,620	284.5	2,705	15,915
3,000	14,400	219.9	2,090	12,310	19,950	304.8	2,895	17,055
3,200	15,360	234.6	2,230	13,130	21,280	325.1	3,090	18,190
3,400	16,320	249.2	2,370	13,950	22,610	345.4	3,280	19,330
3,600	17,280	263.9	2,505	14,775	23,940	365.8	3,475	20,465
3,800	18,240	278.5	2,645	15,595	25,270	386.1	3,670	21,600
4,000	19,200	293.2	2,785	16,415	26,600	406.4	3,860	22,740
4,200	20,160	307.9	2,925	17,235	27,930	426.7	4,055	23,875
4,400	21,120	322.5	3,065	18,055	29,260	447.0	4,245	25,015
4,600	22,080	337.2	3,205	18,875	30,590	467.4	4,440	26,150
4,800	23,040	351.8	3,340	19,700	31,920	487.7	4,635	27,285
5,000	24,000	366.5	3,480	20,520	33,250	508.0	4,825	28,425
5,200	24,960	381.2	3,620	21,340	34,580	528.3	5,020	29,560
5,400	25,920	395.8	3,760	22,160	35,910	548.6	5,210	30,700
5,600	26,880	410.5	3,900	22,980	37,240	569.0	5,405	31,835
5,800	27,840	425.1	4,040	23,800	38,570	589.3	5,600	32,970
6,000	28,800	439.8	4,180	24,620	39,900	609.6	5,790	34,110
6,200	29,760	454.5	4,315	25,445	41,230	629.9	5,985	35,245
6,400	30,720	469.1	4,455	26,265	42,560	650.2	6,175	36,385
6,600	31,680	483.8	4,595	27,085	43,890	670.6	6,370	37,520
6,800	32,640	498.4	4,735	27,905	45,220	690.9	6,565	38,655
7,000	33,600	513.1	4,875	28,725	46,550	711.2	6,755	39,795
7,200	34,560	527.8	5,015	29,545	47,880	731.5	6,950	40,930
7,400	35,520	542.4	5,155	30,365	49,210	751.8	7,140	42,070
7,600	36,480	557.1	5,290	31,190	50,540	772.2	7,335	43,205
7,800	37,440	571.7	5,430	32,010	51,870	792.5	7,530	44,340
8,000	38,400	586.4	5,570	32,830	53,200	812.8	7,720	45,480
8,200	39,360	601.1	5,710	33,650	54,530	833.1	7,915	46,615
8,400	40,320	615.7	5,850	34,470	55,860	853.4	8,110	47,750
8,600	41,280	630.4	5,990	35,290	57,190	873.8	8,300	48,890
8,800	42,240	645.0	6,130	36,110	58,520	894.1	8,495	50,025
9,000	43,200	659.7	6,265	36,935	59,850	914.4	8,685	51,165
9,200	44,160	674.4	6,405	37,755	61,180	934.7	8,880	52,300
9,400	45,120	689.0	6,545	38,575	62,510	955.0	9,075	53,435
9,600	46,080	703.7	6,685	39,395	63,840	975.4	9,265	54,575
9,800	47,040	718.3	6,825	40,215	65,170	995.7	9,460	55,710
10,000	48,000	733.0	6,965	41,035	66,500	1016.0	9,650	56,850
10,200	48,960	747.7	7,105	41,855	67,830	1036.3	9,845	57,985
10,400	49,920	762.3	7,240	42,680	69,160	1056.6	10,040	59,120
10,600	50,880	777.0	7,380	43,500	70,490	1077.0	10,230	60,260
10,800	51,840	791.6	7,520	44,320	71,820	1097.3	10,425	61,395
11,000	52,800	806.3	7,660	45,140	73,150	1117.6	10,615	62,535
11,200	53,760	821.0	7,800	45,960	74,480	1137.9	10,810	63,670
11,400	54,720	835.6	7,940	46,780	75,810	1158.2	11,005	64,805
11,600	55,680	850.3	8,080	47,600	77,140	1178.6	11,195	65,945
11,800	56,640	864.9	8,215	48,425	78,470	1198.9	11,390	67,080
12,000	57,600	879.6	8,355	49,245	79,800	1219.2	11,580	68,220
12,200	58,560	894.3	8,495	50,065	81,130	1239.5	11,775	69,355
12,400	59,520	908.9	8,635	50,885	82,460	1259.8	11,970	70,490
12,600	60,480	923.6	8,775	51,705	83,790	1280.2	12,160	71,630
12,800	61,440	938.2	8,915	52,525	85,120	1300.5	12,355	72,765
13,000	62,400	952.9	9,055	53,345	86,450	1320.8	12,550	73,900

[1]If a regular tool joint is inserted every 90 ft. all values for 4.80-lb. drill pipe will be increased about 2.2 percent, and for 6.65-lb. drill pipe about 1.4 percent.

CREDIT 5 "FIRSTS" TO THERMOID ROTARY HOSE



FIRST with *perfected mechanical wire winding* —assuring uniform tension, close spacing, precision application, and uniform strength.

FIRST with *satisfactory Reinforced Ends 30 inches long*—the ideal length for actual service conditions. Eliminates danger of pinching at couplings.

FIRST with *sixty-foot lengths of hose,* manufactured with full production control and equipment.

FIRST with *successfully developed Neoprene tube* for circulating oil. Resists deteriorating effects of crude oil and abrasive action of sand.

FIRST with *Giant Wire* — extra size for extra strength on tough applications.

The engineering skill that made these "firsts" possible is still at work—creating, developing, refining. Put this skill to work on your job! Specify Thermoid for new and replacement rotary hose!

No. 327 THERMOID GIANT WIRE ROTARY HOSE

USES—For use on all single stage pumps, including the largest now known. A four wire hose, guaranteed to withstand an initial test pressure of 6,000 lbs.

CONSTRUCTION—It contains multiple plies of fabric, and alternate layers of standard and Giant Wire balanced for flexibility to resist elongation loads. Giant Wire gives extra strength as a protection against crush or kink. The layers of wire are floated in a double cushion of live rubber which assures the flexibility required by extreme pump pulsations.

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AIR · STEAM · WELDING
REFINERY HOSE
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FLAT AND V BELTS
BRAKE LININGS
AND BRAKE BLOCKS

★ **Thermoid** ★

PRODUCTS FOR THE OIL INDUSTRY
DISTRIBUTED IN ALL OIL FIELDS BY
OIL WELL SUPPLY COMPANY

CURRENT[1] TAKEN BY ELECTRIC MOTORS, AMP.

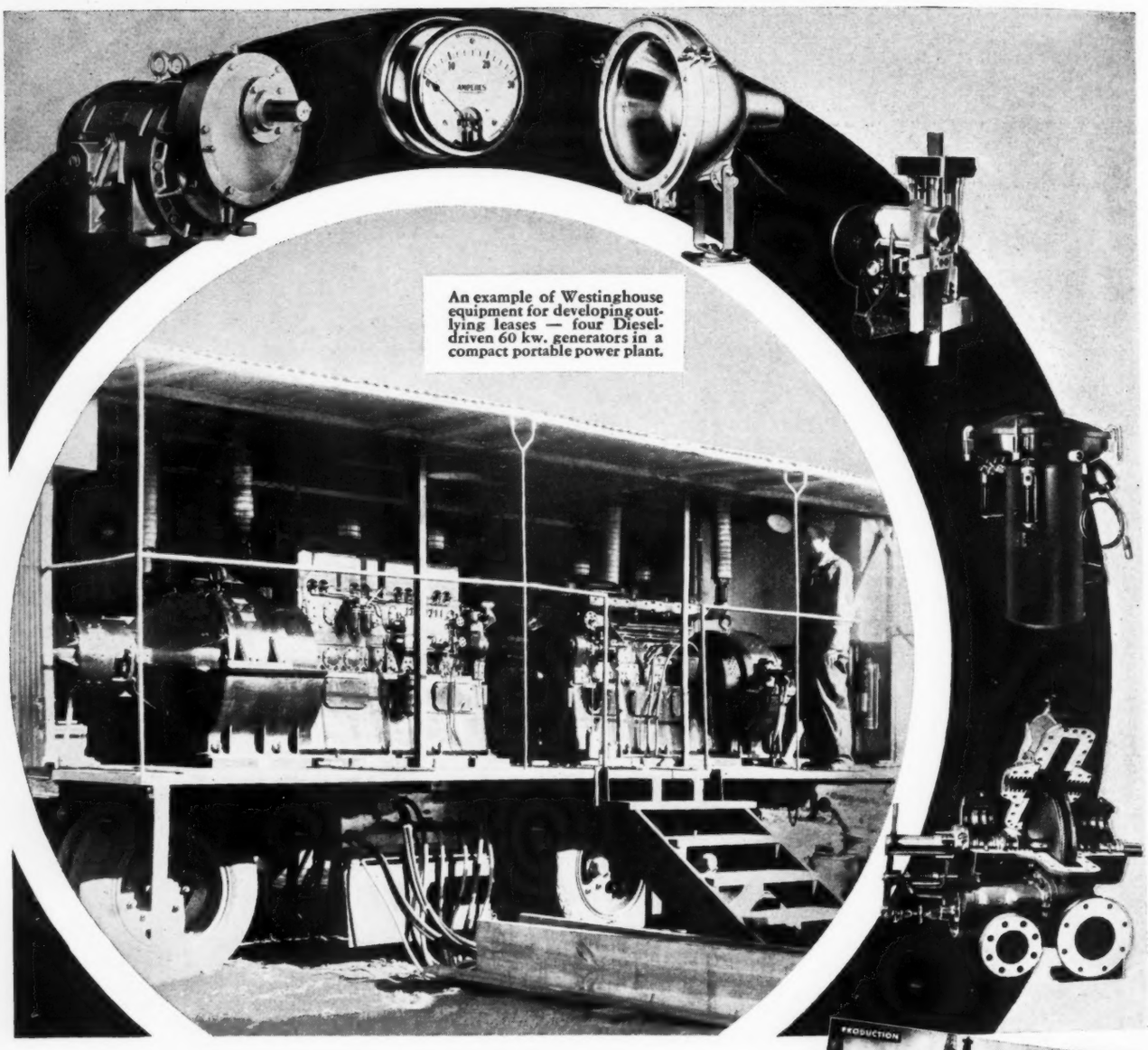
Current taken by d-c. motors[2]				Current taken by 3-phase induction motors[3]			
Horse-power	Voltage			Horse-power	Voltage[4]		
	110	220	500		110	220	550
½	4.5	2.2	1.0	1	6	3	1.2
¾	6.8	3.4	1.5	2	12	6	2.4
1	9.0	4.5	2.0	3	18	9	4
1½	13.6	6.8	3.0	4	24	12	5
2	16.9	8.5	3.8	5	28	14	6
3	25.4	12.7	5.6	10	56	28	11
4	33.8	16.9	7.5	15	85	42	17
5	42.3	21.1	9.3	20	112	56	22
7½	56.5	32.2	12.4	30	167	83	33
10	75.3	37.6	16.6	40	222	110	44
15	113	56.5	24.9	50	278	140	55
20	150	75.3	33.1	60	330	165	66
25	188	94.1	41.6	70	385	192	77
30	226	113	49.7	80	440	220	88
40	301	150	66.3	90	490	245	98
50	376	188	82.8	100	550	275	110
60	452	226	99.4	150	790	395	158
70	527	263	116	200	1050	525	210
80	602	301	132	250	1320	660	264
90	678	339	149	300	1580	790	316

[1]If the current taken is not stated in the specifications it may be determined roughly from the tables.

[2]For single-phase a-c. motors divide the given figure by the power factor.

[3]Current is amp. per wire; power factor 80 percent.

[4]Voltage between wires; the corresponding volts to neutral are 63.5, 127, and 318, respectively.



An example of Westinghouse equipment for developing outlying leases — four Diesel-driven 60 kw. generators in a compact portable power plant.

WESTINGHOUSE SPECIALIZED PRODUCTS SIMPLIFY PETROLEUM PROBLEMS

A complete line of electrical equipment designed especially for the petroleum industry . . . experienced engineers right on the lease to help you apply and service it . . . these are two of the ways in which Westinghouse helps you to simplify your electrical operating problems.

Use these local Westinghouse facilities (in foreign fields, Westinghouse Electric International Company) for every electrical requirement, from a complete installation to repairing a motor. Or, write Westinghouse Electric & Manufacturing Company, Dept. 7-N-42, East Pittsburgh, Pa.

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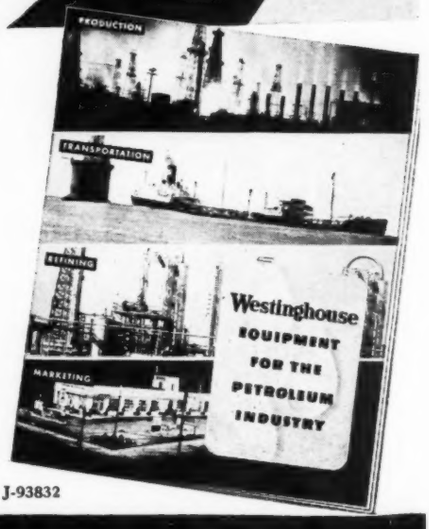
You'll find proof of Westinghouse co-operation in the new booklet (B-2160) "Westinghouse Equipment for the Petroleum Industry." Ask for your copy, free.



J-93832

Westinghouse ELECTRICAL PARTNER OF THE PETROLEUM INDUSTRY

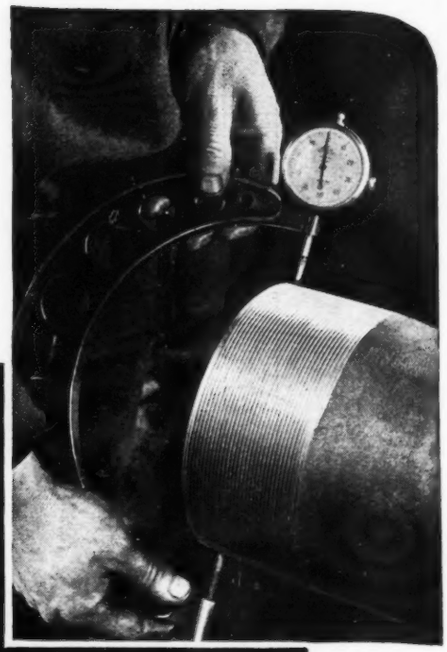
TOTAL[1] UPWARD PRESSURE AT WELL HEAD BETWEEN CASINGS OF VARIOUS SIZES, LB.

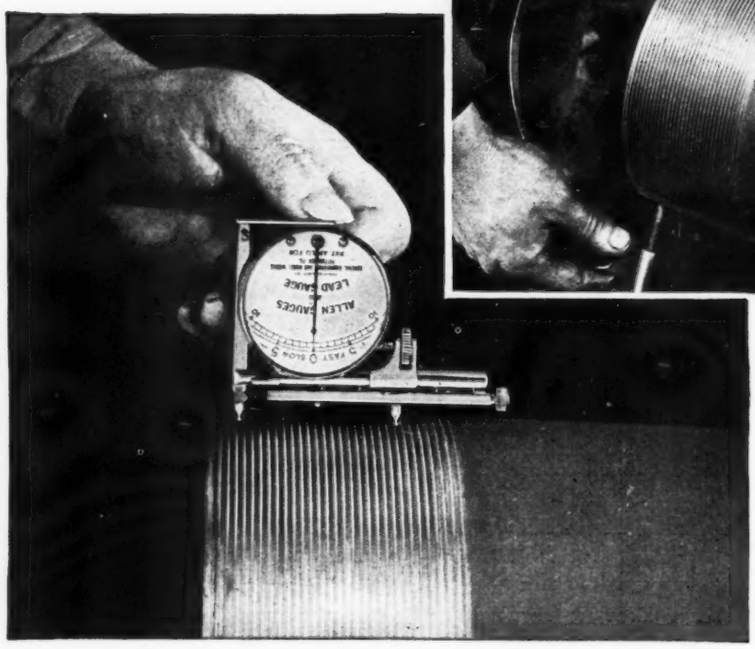
Diam. of larger casing, O.D., in.	Diam. of smaller casing, O.D., in.	Well head pressure, lb. per sq. in. gauge																		
		1000	2000	3000	3500	4000	4500	5000	5500	6000	6250	6500	6750	7000	7200	7400	7600	7800	8000
6⅝	4¾	11,015	22,035	33,050	38,560	44,070	49,575	55,085	60,595	66,100	68,855	71,610	74,365	77,120	79,320	81,525	83,730	85,935	88,135
	5	9,105	18,205	27,310	31,860	36,410	40,965	45,515	50,065	54,620	56,895	59,170	61,445	63,720	65,540	67,360	69,185	71,005	72,825
7	4¾	15,850	31,700	47,555	55,480	63,405	71,330	79,255	87,180	95,105	99,070	103,030	106,995	110,955	114,125	117,295	120,470	123,640	126,810
	5	13,935	27,875	41,810	48,780	55,750	62,715	69,685	76,655	83,620	87,105	90,590	94,075	97,560	100,345	103,135	105,920	108,710	111,495
	5½	9,815	19,630	29,440	34,350	39,255	44,165	49,070	53,975	58,885	61,340	63,790	66,245	68,700	70,660	72,625	74,585	76,550	78,510
7⅝	4¾	20,425	40,845	61,270	71,480	81,690	91,905	102,115	112,325	122,540	127,645	132,750	137,855	142,960	147,045	151,130	155,215	159,300	163,385
	5	18,510	37,020	55,525	64,780	74,035	83,290	92,545	101,800	111,055	115,680	120,310	124,935	129,565	133,265	136,965	140,670	144,370	148,070
	5½	14,385	28,770	43,160	50,350	57,545	64,735	71,930	79,125	86,315	89,910	93,510	97,105	100,700	103,580	106,455	109,335	112,210	115,090
	5¾	12,175	24,355	36,530	42,620	48,710	54,795	60,885	66,975	73,060	76,105	79,150	82,195	85,240	87,675	90,110	92,545	94,980	97,415
8	4¾	25,125	50,250	75,375	87,940	100,500	113,060	125,625	138,190	150,750	157,030	163,310	169,595	175,875	180,900	185,925	190,950	195,975	201,000
	5	23,210	46,420	69,635	81,240	92,845	104,450	116,055	127,660	139,265	145,070	150,870	156,675	162,475	167,120	171,760	176,405	181,045	185,690
	5½	19,090	38,175	57,265	66,810	76,350	85,895	95,440	104,985	114,530	119,300	124,070	128,845	133,615	137,435	141,250	145,070	148,885	152,705
	5¾	16,880	33,760	50,635	59,075	67,515	75,955	84,395	92,835	101,275	105,495	109,715	113,935	118,155	121,530	124,905	128,280	131,655	135,030
	6	14,570	29,145	43,715	51,000	58,290	65,575	72,860	80,145	87,430	91,075	94,720	98,360	102,005	104,920	107,835	110,745	113,660	116,575
8⅛	4¾	26,280	52,560	78,845	91,985	105,125	118,265	131,405	144,545	157,685	164,255	170,825	177,395	183,965	189,225	194,480	199,735	204,990	210,250
	5	24,365	48,735	73,100	85,285	97,470	109,650	121,835	134,020	146,200	152,295	158,385	164,475	170,570	175,440	180,315	185,190	190,065	194,935
	5½	20,245	40,490	60,730	70,855	80,975	91,100	101,220	111,340	121,465	126,525	131,585	136,645	141,710	145,755	149,805	153,855	157,905	161,950
	5¾	18,035	36,070	54,105	63,120	72,140	81,160	90,175	99,190	108,210	112,720	117,230	121,735	126,245	129,850	133,460	137,065	140,675	144,280
	6	15,730	31,455	47,185	55,050	62,910	70,775	78,640	86,505	94,370	98,300	102,230	106,165	110,095	113,240	116,385	119,535	122,680	125,825
8⅝	4¾	32,760	65,515	98,275	114,655	131,030	147,410	163,790	180,170	196,550	204,740	212,925	221,115	229,305	235,860	242,410	248,960	255,510	262,065
	5	30,845	61,690	92,530	107,955	123,375	138,800	154,220	169,640	185,065	192,775	200,485	208,195	215,910	222,075	228,245	234,415	240,585	246,750
	5½	26,720	53,440	80,165	93,525	106,885	120,245	133,605	146,965	160,325	167,005	173,685	180,365	187,045	192,390	197,735	203,080	208,425	213,770
	5¾	24,510	49,025	73,535	85,790	98,050	110,305	122,560	134,815	147,070	153,200	159,330	165,455	171,585	176,485	181,390	186,290	191,195	196,095
	6	22,205	44,410	66,615	77,720	88,820	99,920	111,025	122,130	133,230	138,780	144,330	149,885	155,435	159,875	164,315	168,760	173,200	177,640
	6⅝	16,005	32,015	48,020	56,025	64,030	72,030	80,035	88,040	96,040	100,045	104,045	108,045	112,050	115,250	118,450	121,655	124,855	128,055
	7	11,995	23,990	35,980	41,980	47,975	53,975	59,970	65,965	71,965	74,960	77,960	80,960	83,960	86,355	88,755	91,155	93,555	95,950
9	5½	30,220	60,435	90,655	105,765	120,870	135,980	151,090	166,200	181,310	188,860	196,415	203,970	211,525	217,570	223,615	229,655	235,700	241,745
	5¾	28,010	56,020	84,025	98,030	112,035	126,040	140,045	154,050	168,055	175,055	182,060	189,060	196,065	201,665	207,265	212,870	218,470	224,070
	6	25,700	51,405	77,105	89,955	102,810	115,660	128,510	141,360	154,210	160,640	167,065	173,490	179,915	185,055	190,195	195,335	200,475	205,615
	6⅝	19,505	39,010	58,510	68,265	78,015	87,770	97,520	107,270	117,025	121,900	126,775	131,650	136,530	140,430	144,330	148,230	152,130	156,030
	7	15,490	30,980	46,475	54,220	61,965	69,710	77,455	85,200	92,945	96,820	100,690	104,565	108,435	111,535	114,635	117,730	120,830	123,930
9⅝	5¾	36,540	73,075	109,615	127,885	146,150	164,420	182,690	200,960	219,230	228,360	237,495	246,630	255,765	263,075	270,380	277,690	284,995	292,305
	6	34,230	68,460	102,695	119,810	136,925	154,040	171,155	188,270	205,385	213,945	222,500	231,060	239,615	246,465	253,310	260,155	267,000	273,850
	6⅝	28,035	56,065	84,100	98,115	112,130	126,150	140,165	154,180	168,200	175,205	182,215	189,225	196,230	201,840	207,445	213,050	218,655	224,265
	7	24,020	48,040	72,060	84,070	96,080	108,090	120,100	132,110	144,120	150,125	156,130	162,135	168,140	172,945	177,750	182,550	187,355	192,160
	7⅝	16,840	33,680	50,525	58,945	67,365	75,785	84,205	92,625	101,045	105,255	109,465	113,675	117,885	121,255	124,625	127,990	131,360	134,730

The fact that total well head pressures for unit pressures as high as 8000 lb. per sq. in. are included in the table should not be interpreted as indicating that the casing will have sufficient bursting strength to withstand such pressure. For bursting strength of casing see Table P432.2, p. 257, August, 1937, issue.

[1]Total for lightest weight casing, hence a maximum for each size casing.

A PIPE'S REPUTATION MAY "*HANG BY A SINGLE THREAD*"





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Bridgeport Machine Co., Wichita, Kansas, and Branches.

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February, 1938

THE Petroleum Engineer

Dallas, Texas

Vol. 9 No. 5
In Two Sections
Part 2

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January to December

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